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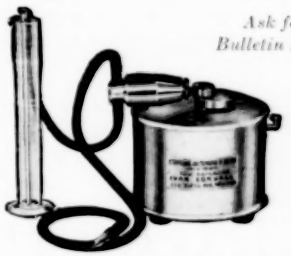

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THE QUARTERLY REVIEW *of* BIOLOGY

HYPOPHYSEAL FUNCTIONS IN THE TOAD BUFO ARENARUM HENSEL

By BERNARDO A. HOUSSAY

Instituto de Biologia y Medicina Experimental, Buenos Aires

THE study of the functions of the hypophysis of *Bufo arenarum* Hensel (and other batrachians) was started forty years ago in Argentina. This toad is perhaps the species in which the largest number of functions related to the hypophysis has been found and studied. The importance of this work lies in the general principle of endocrinology that hormonal actions have a fundamental similarity in all species.

The hypophysis is necessary for the preservation of the life of the individual toad and also of the species. Its removal is followed by metabolic disturbances which are fatal in a few weeks, and by interference with the sexual functions, which prevents reproduction. Personal experience with over twenty thousand individuals of the species *Bufo arenarum* Hensel, has convinced the author of the many advantages it has for experimental purposes. It is easy to obtain in large numbers cheaply. It has great resistance to trauma. It offers facility of operative techniques; a great variety and severity of the symptoms of hypophyseal insufficiency; rapidity and intensity in its response to the implantation of one or the other of the lobes of the hypophysis; and the possibility of making experiments and obtaining proofs more easily and in larger numbers than with any other animal.

This toad is preferable to the frog *Leptodactylus ocellatus* (L.) Gir., which was studied in 1910 to 1916 and in 1924, and which is common in the Argentina, but is much less resistant.

The symptoms of hypophysectomy or hypophyseal insufficiency observed in *Bufo arenarum* are very similar, except for slight differences, in *Leptodactylus ocellatus* (L.) Gir. (Houssay, 1910, 1916; Houssay and Ungar, 1924a, b, 1925a, b); *Bufo marinus*, *Bufo paracnemis*, *Bufo d'Orbigny*, *Ceratophrys ornata*, *Hyla* sp., and *Atelopus stelzneri*. (In the first papers published by myself and my collaborators *Bufo arenarum* Hensel was mistakenly called *Bufo marinus* (L.) Schneid, according to the advice of the zoologists consulted; but in 1930 the error was corrected and since then the right name has been used.)

ANATOMICAL DATA

The hypophysis of the toad is made up of the adenohypophysis and the neurohypophysis. The adenohypophysis has three parts: 1) pars distalis; 2) pars intermedia; 3) pars tuberalis.

The *pars distalis* (chromophil lobe or pars chromophila), which is the distal lobe and corresponds to the anterior lobe of mammals, is situated posteriorly in the toad, and for this reason should not be called "anterior lobe." The names principal lobe or glandular lobe, used to differentiate it from other parts of the hypophysis must be discarded because of lack of accuracy. The

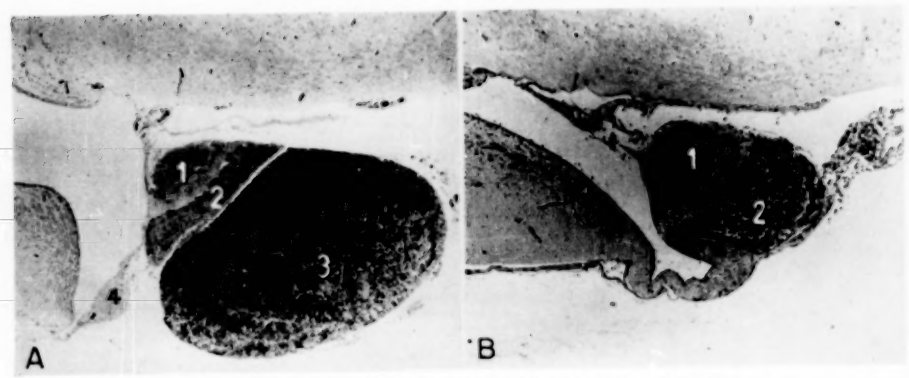

FIG. 1. SECTIONS OF THE HYPOPHYSIS OF BUFO ARENARUM HENSEL

A, Control. B, Two months after extirpation of pars distalis. 1, pars nervosa; 2, pars intermedia; 3, pars distalis; 4, eminentia media.

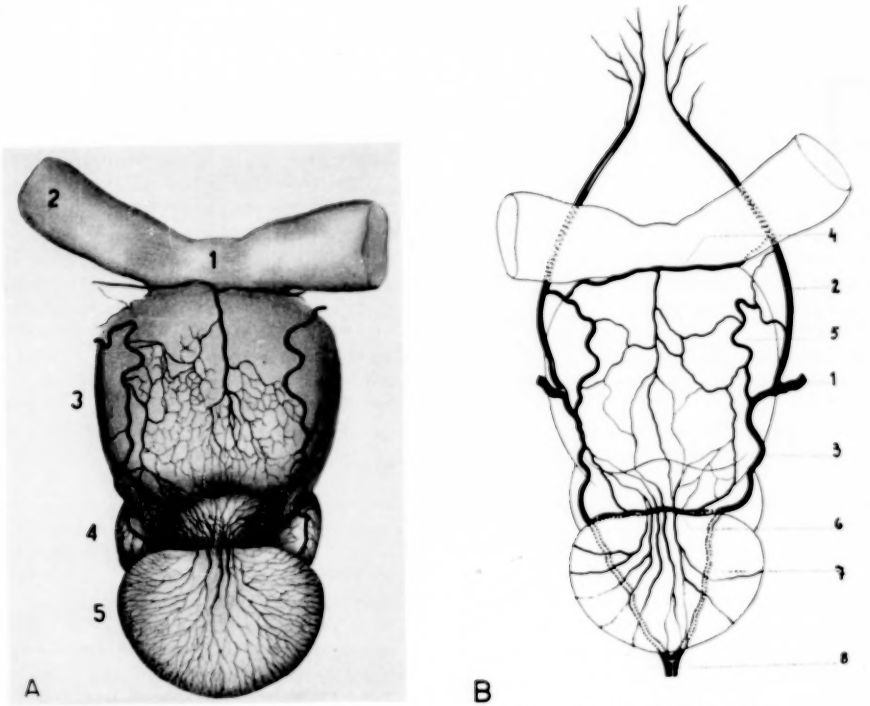

FIG. 2. INFUNDIBULO-TUBERAL REGION OF BUFO ARENARUM HENSEL —VENTRAL ASPECT

A, 1, optic chiasma; 2, optic nerve; 3, infundibulotuberal region; 4, neuro-intermediate lobe; 5, pars distalis, behind the eminentia media of the tuber. Blood circulates from the infundibulo-tuberal region toward the hypophysis. B, 1, cerebral carotid artery; 2, anterior branch of same; 3, posterior branch of same; 4, retro-chiasmatic branches; 5, infundibular branches; 6, retroinfundibular anastomoses; 7, anastomotic branches of the vertebral artery; 8, vertebral artery.

histological structure of this lobe has been described by Houssay (1910, 1916), Trefogli (1915), Houssay, Giusti, and Lascano Gonzalez (1929), Houssay, Biasotti, and Sammartino (1935), Masselin (1940), Porto (1940), and by Prieto Díaz and Echave Llanos (1947).

The first papers published on the histology of the pars distalis described acidophil, basophil, and chromophobe cells, but with modern staining techniques the following types of cells can be distinguished: azocarminophil, orangephil, small or typical and large cyanophil, active and inactive chromophobe (Prieto Díaz and Echave Llanos, 1947). In animals kept in the dark, or after their eyes have been removed, acidophil cells increase in number; and they are less numerous in animals exposed to light or after stimulating the optic nerve (Masselin, 1939).

The *pars tuberalis* and the neurohypophysis of *Bufo arenarum* Hensel, has been studied by Atwell (1941).

The *neurohypophysis* is formed, according to Atwell, by the following four parts: 1) the neural lobe proper, which has sometimes been called the processus infundibuli or pars nervosa; 2) the thin floor of the infundibulum; 3) the median eminence; 4) the pars ventralis hypothalami.

The *pars intermedia* and neural lobe proper are closely united, forming a lobe which is the equivalent of the posterior lobe of mammals but has an anterior position in the toad (Fig. 1). It can be called the proximal or neuro-intermediate lobe.

The hypophysis is situated behind the infundibular lobe of the brain, which is a part of the hypothalamus behind the optic chiasma. This is known as the infundibulo-tuberal region. The supraoptic nucleus is situated deeply, in front of the chiasma; it is fairly large and sends fibers to the hypophysis (Greving, 1928; Scharrer, 1934).

The ventral aspect of the pars distalis receives its blood supply through a portal system of small vessels which originate in two lateral arteries, branches of the antero-cerebral artery, and a median artery, a branch of the retrochiasmatic artery (Fig. 2). Direct examination of the living animal has shown that the blood flows backwards from the neurohypophysis to the pars distalis (Houssay, Biasotti, and Sammartino, 1935). This has been confirmed by Green (1947) for other batrachians. Section of these vessels causes necrosis in the ventral, middle, and anterior aspects of the pars distalis, but not in the dorsal and posterior aspects, which obtain their blood supply from other arteries (Fig. 3).

The dorsal and posterior aspects of the pars distalis are supplied by a retroinfundibular branch of the posterior branch of the cerebral carotid artery (3) which crosses the postero-superior aspect of the neural lobe, and anastomoses with the homologous artery on the opposite side (6); also by an artery which is a continuation of the posterior branch of the cerebral carotid artery

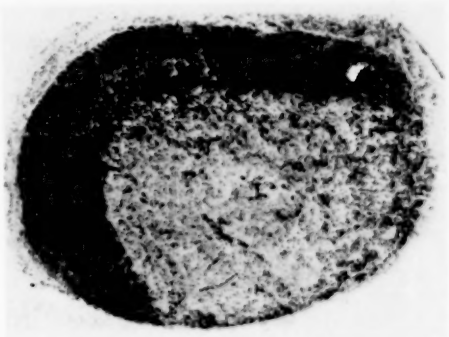

FIG. 3. ISCHEMIC NECROSIS OF THE ANTERIOR, VENTRAL, AND CENTRAL PARTS OF THE PARS DISTALIS OF BUFO ARENARUM HENSEL, AFTER SECTIONING THE SUPERFICIAL INFUNDIBULAR VESSELS

(7) and which anastomoses with the basilar artery (8).

METHODS OF STUDY

The whole distal lobe can be easily extirpated (Fig. 1, B). Subsequent removal of the neuro-intermediate lobe converts the operation into a total hypophysectomy. Extirpation of the proximal lobe alone, or of one of its parts, cannot be performed in the adult toad.

The functions of the hypophysis and the infundibulo-tuberal region can be studied by producing localized lesions, by extirpation of the whole gland or of different parts, and by implantation or injection of extracts of the different lobes. The following techniques have been used systematically by the author and his collaborators: a) transphenoidal extirpation of the distal lobe or of the entire hypophysis (Houssay, 1910, 1916; Giusti and Houssay, 1924; Houssay, A., 1945); b) puncture of the infundibulo-tuberal region (Giusti and Houssay, 1922, 1923, 1924; Lascano-Gonzalez, 1935; Houssay, Biasotti, and Sam-

martino, 1935); c) subcutaneous implantation or injection of the whole hypophysis of the toad, or of the distal or neuro-intermediate lobe separately; d) injection of extracts of the different parts of the hypophysis of mammals or other vertebrates, or of hormones extracted from them.

FUNCTIONS OF THE HYPOPHYSIS

In this toad the hypophysis plays a part in the following functions: metabolism, growth, the regulation of endocrine glands and sexual function, the circulation of the blood, diuresis, the regulation of the pigment of the skin, etc. Over 200 papers have been published on these functions, including summaries by Houssay and Giusti (1929, 1930) and by Houssay (1936).

The symptoms observed can be classified into four large groups, according to their functional origin: 1) hypophyseal insufficiency; 2) hypophyseal hyperactivity; 3) infundibulo-tuberal symptoms; 4) infundibulo-hypophyseal symptoms.

FUNCTIONS OF THE PARS INTERMEDIA

Skin color. Changes of color in the skin are due to movements of the pigment granules (chromatosomes) within the chromatophore cells which are found in the skin and other tissues of the toad. The color of the skin in the toad (Stoppani, 1941, 1942) depends on: 1) the secretion of a hormone by the pars intermedia, which disperses the melanosomes and erythrosomes in the pigment cells and darkens the skin; 2) adrenaline secreted by the adrenals, which concentrates the pigments and lightens the skin; and 3) the action of adrenergic nerves which lightens the skin. Cholinergic nerves have not been found in this species. The normal color of the skin depends on the continuous secretion of a hormone by the pars intermedia and its darkening and lightening upon an increase or a decrease in the secretion.

Albinotic hypophysectomized batrachian larvae are darkened by grafting pars intermedia (Allen, 1920, 1930; Atwell, 1920, 1937; Swingle, 1921, in other batrachians). Immersion in extracts of pars intermedia also darkens the larvae (Atwell, 1919; Smith, 1920, in other batrachians).

Several names have been given to the hormone responsible for these effects: chromatosome-dispersing hormone; melanosome-dispersing hormone; melanotrope hormone; intermedin. The term melanophore dilatation is not correct, however, as there is dispersion of the melanosomes through the protoplasm and no dilatation or contraction of the melanocytes. Intermedin is not the first name to be used, but it is short and in batrachians the hormone is produced by the pars intermedia; in animals which have no pars intermedia, such as the whale, it is produced by the pars distalis.

After total hypophysectomy (Fig. 4, right and B) the skin becomes pale in a few minutes, due to concentration of the melanosomes in the melanocytes (melanophores). In the adult toad it has not been possible to extirpate the pars intermedia alone, but in other batrachians the effects of its removal alone have been observed. In cases of pathological destruction (Bayer, 1930) or extirpation of the pars intermedia in larvae (Atwell and Holley, 1936), there is concentration of the pigment and paleness of the skin, which are not observed if the distal lobe alone is removed (Hogben and Winton, 1922, in European frogs; Houssay and Ungar, 1924, 1925, in *Leptodactylus ocellatus;* Giusti and Houssay, 1924; Puente, 1927; Porto, 1936; Stoppani, 1940, 1942, in *Bufo arenarum* Hensel).

The color of hypophysectomized toads is darkened by the injection of extracts of the different parts of the hypophysis of batrachians and mammals (Fig. 4, left; and A). The extracts of the pars intermedia are the most active and those of the pars distalis are least active (Houssay and Ungar, 1924, 1925; Houssay and Giusti, 1929, 1930; Stoppani, 1941). The strength of extracts of neuro-intermediate lobes of *Bufo arenarum* is 7 times that of the distal lobes of the same animals.

The pars intermedia of batrachians, then, secretes the chromatosome-dispersing hormone and controls the color of the skin. In mammals the pars intermedia gives the most potent extracts, and in tissue cultures it also secretes the hormone (Geiling and Lewis, 1935, mouse; Anderson and Haymaker, 1935, rat). Atrophy of the neurohypophysis, produced by its denervation, causes the disappearance of the oxytocic and vasopressor hormones, but the melanophore-dispersing hormone persists, because the pars intermedia does not undergo atrophy (Fischer, 1937, cat). In cetaceans and in the armadillo there is no pars intermedia. In these animals the melanosome-dispersing hormone is found in the anterior lobe and not in the neurohypophysis (Geiling, 1942).

The skins of toads in darkness, in winter, or

if they are blind, darken, and the melanosome-dispersing hormone increases in the hypophysis (Masselin, 1939) and in the blood (Stoppani, 1941, 1942). Light or stimulation of the optic nerves causes the skin to pale and diminishes the concentration of hormone in the skin and in blood.

There are nerve centers situated in the infundibulo-tuberal region which cause the skin to become pale when they are stimulated directly, or reflexly through the optic nerve. This stimulation inhibits the secretion of the melanosome-dispersing hormone and in some cases increases adrenaline secretion (Stoppani, 1940, 1941).

Hypophysectomized toads do not become dark, as normal ones do, when put in darkness and they do not respond to many drugs which darken normal toads, with the exception of caffein, theobromin and barium, which are active (Stoppani, 1941, 1942).

Retinal pigment. Changes in pigmentation of the retina occur in the opposite direction to those of the skin—light disperses and darkness con-

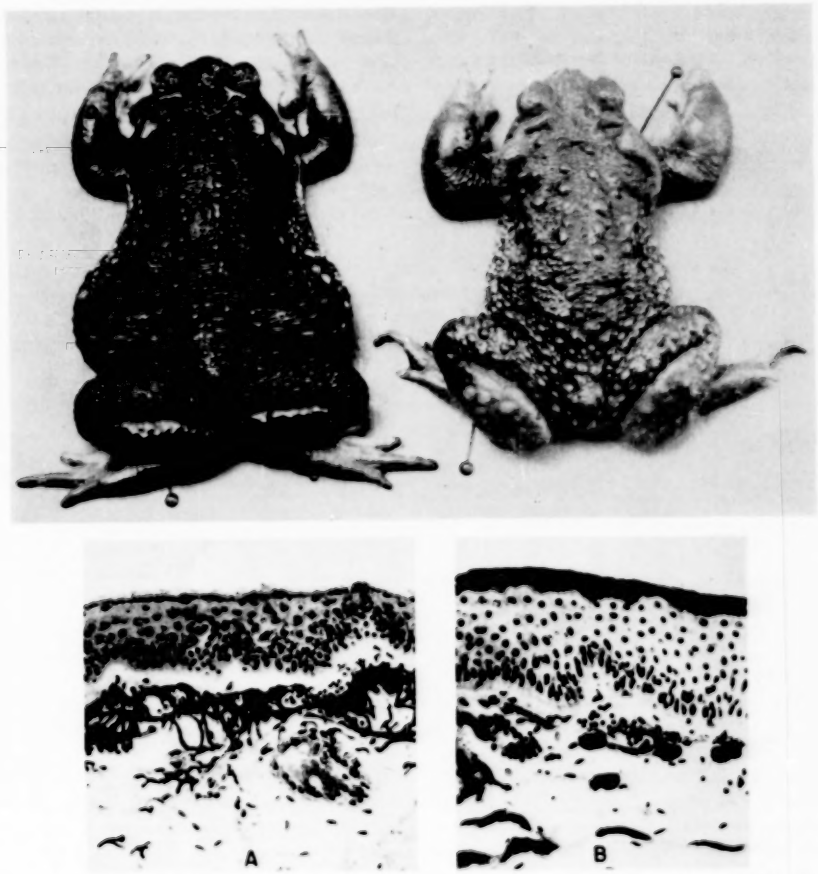

FIG. 3. BUFO ARENARUM HENSEL. LEFT, AFTER INJECTION WITH NEURO-INTERMEDIATE LOBE EXTRACT, AND RIGHT, AFTER HYPOPHYSECTOMY

A, Injected with neuro-intermediate lobe extract: the melanotic pigment is dispersed within the melanophores. B, Hypophysectomized: thick epidermal cuticle formed and not shed; the melanotic pigment concentrated within the melanophores.

centrates the pigment in the retina. The normal dispersion of the retinal pigment when the eye is exposed to light depends on the secretion of the neurointermediate lobe. In hypophysectomized animals this dispersion is considerably reduced, but again occurs when an extract of this lobe is injected (Sverdlick, 1942) (Fig. 5). In hypophysectomized toads the response to darkness is not modified. Removal of the distal lobe only does not modify the response of the retinal pigment to light and darkness.

FUNCTIONS OF THE NEUROHYPOPHYSIS

Hormones secreted by the neurohypophysis regulate vascular tonus and diuresis. In mammals it has been proved that the neurohypophysis and not the pars intermedia is responsible for the regulation of diuresis (Fischer, 1937; Geiling, 1942) but in batrachians it has not been possible to demonstrate whether these functions depend on the pars intermedia or on the pars nervosa. *Vascular tone:* In batrachians the hormones of the neurohypophysis are of great importance for the maintenance of tone in arterioles and capillaries and therefore of the blood pressure level. A few hours after total extirpation of the hypophysis there is *dilatation of the capillaries and small arterioles*. The capillaries are always considerably dilated and the circulation is slowed down in the skin (in European frogs, Krogh and Rehberg, 1922; in *Bufo arenarum*, Aubrun and Porto, 1934; Aubrun, 1935; Porto, 1936), the glomeruli of the kidney (Pasqualini, 1938, 1941), the stomach and intestine (Houssay, Foglia, and Fustinoni, 1937, 1941) and the hepatic sinusoids (De Robertis, 1939). On the other hand, extirpation of the pars distalis causes little or no capillary dilatation.

Injection of pars distalis does not counteract this capillary dilatation. Injection of neurointermediate lobe has a more or less complete effect, less in the skin than in other regions. It has been claimed that a vasoconstrictor substance has been found in normal blood (Neubach, 1937). Perfusion of the hind legs of totally hypophysectomized toads with normal saline soon produces edema (Senderey, 1942).

A rapid, intense and progressive fall in *arterial blood pressure* (Orías, 1934) is observed a few hours after total hypophysectomy (Fig. 6). The blood pressure falls from 40 mm. Hg to 24 mm. Hg within a week and to 17 mm. Hg in a month. Removal of the distal lobe does not cause hypotension in the first weeks, but there is a moderate fall (to 30 mm. Hg) when, after 30 days, the animal becomes asthenic. The injection of neuro-intermediate or of distal lobe (this last being less active) causes a rise in blood pressure. Less blood can be obtained by bleeding from hypophysectomized toads than from normal animals, because it remains within the blood vessels. The total amount of blood, erythrocytes, and hemoglobin (Welcker's method) are almost the same in hypophysectomized animals as in controls (Aubrun, 1935; Parodi, 1937). The concentration of erythrocytes is decreased in heart and arterial blood (30%

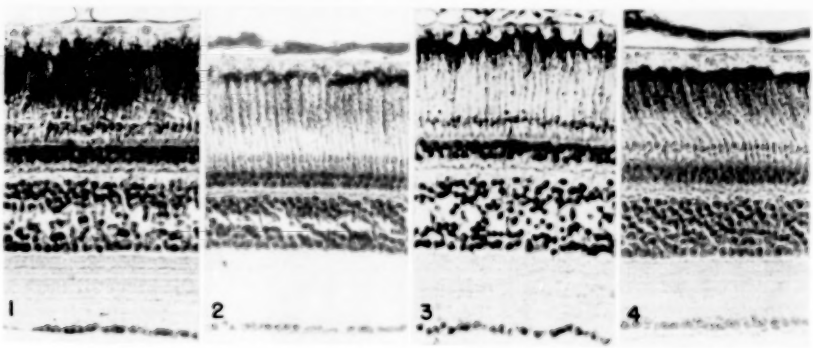

FIG. 5. PHOTOMICROGRAPH OF SECTIONS OF RETINA OF BUFO ARENARUM HENSEL

Changes in retinal pigment upon exposure to light. 1, normal, total dispersion; 2, normal, injected with posterior lobe, total dispersion; 3, total hypophysectomy, pigment concentration; 4, total hypophysectomy, injected with posterior lobe, total dispersion.

below the normal) but is increased in the small vessels (capillaries and small veins); leucopenia also results, with a decrease in granulocytes and monocytes (Varela and Sellarés, 1934; Parodi, 1937. Hydremia is accompanied by a decrease in the plasmatic concentration of potassium and sodium chloride. Hypophyseal extracts raise the blood pressure in amphibians (Houssay, 1910; Houssay, Giusti, and Lahille, 1912; Houssay, Giusti, and Lascano-Gonzalez, 1921; Orías, 1934).

Regulation of diuresis. The neurohypophysis decreases diuresis by increasing reabsorption by the renal tubes of part of the water filtered through the glomeruli. Total hypophysectomy causes intense polyuria in 70 per cent of the operated toads (Pasqualini, 1935, 1938), but polyuria occurs in only 33 per cent of the animals in which the distal lobe alone has been removed. It seldom occurs, and then only transitorily, after lesions have been made in the tuber. It can be suppressed by injecting toad neuro-intermediate lobe, or the posterior lobe of mammals. Large doses cause anuria (Houssay and Potick, 1929; Pasqualini, 1938).

Polyuria caused by hypophysectomy is of renal origin and can be observed in toads not immersed in water. Absorption of water by the skin takes place at the same rate in hypophysectomized toads, nephrectomized or with both ureters tied, as in controls with the hypophysis intact. The pars distalis plays no part in this polyuria and is not necessary for its production (Pasqualini, 1935, 1938).

Hypophysectomized toads are not edematized nor do they increase in weight. The injection of large doses of posterior lobe extract causes edema and increase in weight in normal and in hypophysectomized toads (Biasotti, 1922; Novelli, 1932, 1936; Pasqualini, 1938). This seems to depend on the functions of the skin and kidneys (Novelli, 1936).

FUNCTIONS OF THE PARS DISTALIS

The pars distalis has many and important functions. Extirpation of this part is followed by severe symptoms and death after a few weeks. Both total hypophysectomy and removal of the pars distalis alone produce these severe symptoms, but after total extirpation they have a more rapid course. There are morphogenetic, endocrine, and sexual disturbances, which are remedied only by implantation or injection of the pars distalis. Some of the metabolic symptoms improve by treatment with neuro-intermediate lobe, but the pars distalis always has greater activity.

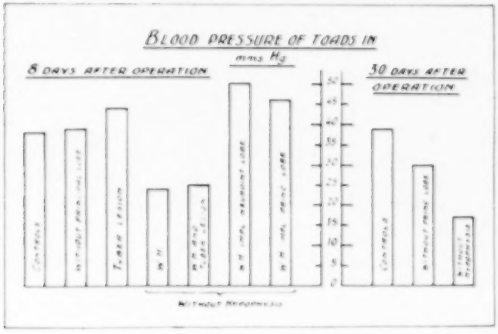

FIG. 6. VASOTONIC PHYSIOLOGICAL ACTION OF THE HYPOPHYSIS IN BUFO ARENARUM HENSEL
Principal lobe, pars distalis; WH, hypophysectomized. (From Orías, 1934.)

Growth

Growth is retarded and in some cases completely arrested after hypophysectomy in amphibians. On the contrary, administration of pars distalis accelerates growth. These facts have been repeatedly observed since 1916 by Allen, Smith, and others, in the larvae of several species of batrachians, but they have not been studied in *Bufo arenarum*. In the liver of adult hypophysectomized toads (De Robertis, 1939) the cell volume decreases, the Golgi apparatus and the chondrioma are altered, glycogen and fats are diminished.

Some of the cells are dark and atrophied. Implantation of the pars distalis reestablished normality.

Unilateral nephrectomy causes a 23 per cent increase in the weight of the remaining kidney in hypophysectomized animals; in the controls the increase is 58 per cent. Implantation of total hypophysis causes an increase of 100 per cent; but the increase is only two-thirds of this value if the distal lobe or the neuro-intermediate lobe alone are implanted (Gonzalez, 1938).

adrenal cortex has been observed in all the species of animals studied. In the toad, following removal of the pars distalis or total hypophysectomy, atrophy of the adrenal cortex is not easily demonstrated, but the cells are full of large drops of fat and have the aspect associated with hypofunction. Injection of mammalian or toad pars distalis changes the picture to one of hyperactivity (Porto, 1940).

Hypophysectomy does not change the adrenalin content of the adrenals in the toad, nor is the

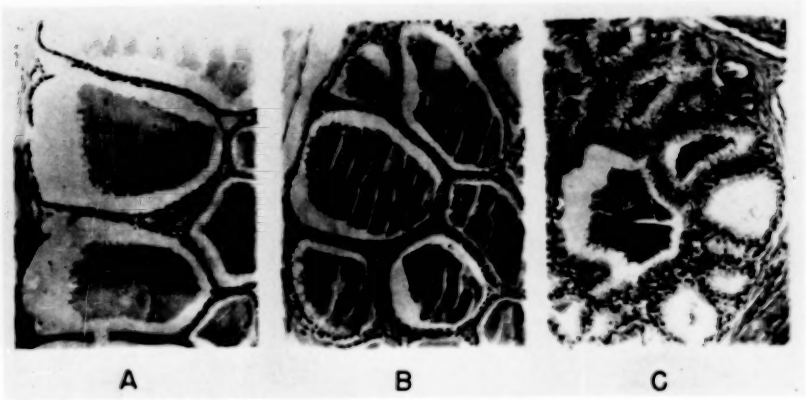

FIG. 7. THYROID OF BUFO ARENARUM HENSEL

A, One month after hypophysectomy. B, Normal control. C, Intact animal, one day after implantation of pars distalis.

Endocrine Regulation

Thyroid. Following hypophysectomy the thyroid epithelium shows signs of atrophy (Magdalena, 1932; Galli Mainini, 1935). It becomes flat, the vesicles are considerably enlarged, and the colloid is homogeneous and stains intensely (Fig. 7). After subtotal thyroidectomy there is no compensatory hypertrophy in hypophysectomized animals (Magdalena, 1934). The administration of pars distalis produces hyperplasia and hyperactivity of the thyroid (Fig. 7, C): the epithelium has high cells and there is vacuolisation and reabsorption of colloid (Magdalena, 1933). Mammalian thyrotrophin stimulates the thyroid of the toad. The effect is proportional to the dose, so this method can be used in the assay of this hormone (Galli Mainini, 1943).

Adrenals. The pars distalis of the hypophysis has a continuous stimulating effect on the adrenal cortex. After hypophysectomy, atrophy of the chromophil reaction altered (Houssay and Mazzocco, 1933).

Sexual Functions

The pars distalis of the hypophysis secretes gonadotrophins which develop and maintain the normal structure and functions of the gonads. The gonads secrete hormones which develop and maintain the sexual characters.

At the end of winter, the gonads are at the maximum of their development, and at the beginning of spring, amplexus (sexual clasping) takes place. During amplexus there is in both sexes hypersecretion of gonadotrophins, which act on the gonads. In the female this provokes ovulation and oviposition; in the male it produces amplexus and then the release and expulsion of spermatozoa. Amplexus does not provoke ovulation in the female after removal of the pars distalis (Houssay, 1934, 1936, 1947). Gonadotrophins have been

found circulating in the blood only in exceptional cases during amplexus (Houssay, 1947).

Females. Hypophysectomy does not cause visible or appreciable ovarian atrophy, at any rate for the first two months after the operation; but the ovaries become less sensitive to gonadotrophin (Houssay, 1947).

Implantation or injection of pars distalis of toad hypophysis provokes ovulation in 15 hours to 3 days (Houssay, Giusti, and Lascano-Gonzalez, 1929; Houssay and Giusti, 1930; Houssay, 1946, 1947), always provided that there are eggs sufficiently mature.

The hypophysis of *Bufo arenarum* provokes ovulation in several batrachian species: *Bufo arenarum*, *Bufo marinus*, *Bufo paracnemis*, *Bufo d'Orbigny*, *Leptodactylus ocellatus* (Houssay, 1936, 1943, 1947; Houssay and Giusti, 1930), *Xenopus laevis* (Shapiro, 1943) and *Rana pipiens*, but has no gonadotrophic activity in normal or hypophysectomized mammals (Foglia, 1946).

Bufo arenarum females ovulate when injected with the hypophysis of the species just mentioned, with the exception of *Xenopus laevis* (Shapiro, 1943). Ovulation is also evoked by large doses of chorionic gonadotrophin and pregnant mare serum (Houssay, 1947; Galli-Mainini, 1947). It is remarkable that this species does not ovulate when injected with urine from pregnant women, or with mammalian hypophysis (Houssay and Giusti, 1930; Houssay, 1947b,f).

The oviduct develops and its structure and functions are maintained by the action of the hypophysis and the sexual hormones. Castration at a very early age does not prevent the development of the glands of the oviduct (Pomerat, 1940). On the other hand, castration or hypophysectomy are followed by atrophy of the oviduct in the adult female (Houssay, 1947e,f).

During ovulation the oviduct produces a jelly-like secretion, which forms transparent tubes in the interior of each of which the eggs are situated in a row. This secretion is dependent upon the hormones of the hypophysis. It is produced by the injection of pars distalis and can be observed in castrated females (Allende, 1938, 1939; Houssay, 1947). It can be studied by closing a segment or the whole oviduct between two ligatures (Allende's method) and injecting the substances to be assayed, either subcutaneously (Allende, 1938) or within the oviduct (Houssay, 1947e).

Secretion is provoked by toad, rat, or human hypophysis (Houssay, 1947), and by the hypophysis of some species of fish (Ribeiro and Tabarelli Neto, 1943). Gonadotrophins are not active, but prolactin provokes secretion even after ovariectomy (Allende, 1938, 1939; Houssay, 1947). Prolactin seems to have a maternal function, related to the nutrition of the offspring, by means of the secretion of milk in mammals, of the crop-glands in the pigeon, and of the oviduct in the toad.

Progestational hormones evoke the gelatinous secretion of the oviduct. Progesterone and ethyniltestosterone have great activity (Houssay, 1947). Desoxycorticosterone, ethynilandrostenediol (Houssay, 1947), ascorbic acid (Tabarelli Neto, 1945; Allende, unpublished; Houssay, 1947), and thiamine (Allende, unpublished) have less or inconstant activity.

Males. Gonadotrophins develop and maintain the normality of the testes. Removal of the pars distalis provokes a slow atrophy of the testes (Fig. 8) (Giusti and Houssay, 1923, 1924; Houssay, Giusti, and Lascano Gonzalez, 1929; Houssay and Giusti, 1930) and there is no compensatory hypertrophy after subtotal extirpation of the testes (Houssay, Giusti, and Lascano Gonzalez, 1929). Injection or implantation of hypophysis increases the size and produces slow hypertrophy of the testes (Giusti and Houssay, 1923, 1924; Houssay, Giusti, and Lascano Gonzalez, 1929; Houssay and Giusti, 1930). The administration of pars distalis produces erotization of the males, provoking sexual clasping, but not in castrated animals. There is also a very rapid release of spermatozoa (Houssay, Giusti, and Lascano Gonzalez, 1929; Houssay, 1947; Galli-Mainini, 1947). The Sertoli cells become swollen and vacuolized, and the spermatozoa are set free, and then pass through some of the nephrons of the kidneys and ureters to the cloaca (De Robertis, Burgos, and Breyter, 1945; Galli-Mainini, 1947; Houssay, 1947). Release of spermatozoa has also been observed in vitro by applying chorionic gonadotrophin to slices of testicular tissue (Burgos and Mancini, 1947).

This effect can be produced by the administration of toad, rat, or human hypophysis or of chorionic gonadotrophin in the urine of pregnant women and the serum of pregnant mares (Galli-Mainini, 1947; Houssay, 1947) and by the gonadotrophins of sheep hypophysis, luteinizing hor-

mone (LH or ICSH) and follicle-stimulating hormone (FSH) (Houssay, 1947).

The release of spermatozoa can be obtained with 1/400 to 1/100 the dose necessary to produce ovulation in the female (Houssay, 1947; Galli-Mainini, 1947). The minimum active doses are: pars distalis of toads, 0.04 mg. in males, and 0.25–0.50 mg. in females; chorionic gonadotrophin, 15 to 30 I.U. in the male and 250 to 5000 I.U. in the female; pregnant mare serum gonadotrophin, 100 to 200 I.U. in the male and 20,000 to 40,000 in the female.

The injection into male toads of the urine of women in their first five months of pregnancy evokes the evacuation of spermatozoa within three hours, in 99.5 to 100 per cent of cases; but only in 92 per cent of cases when urine of women in the sixth to the ninth month or pregnancy is used. This method for the diagnosis of pregnancy (Galli-Mainini's pregnancy test) is the most rapid, sensitive, and accurate of all the pregnancy tests so far proposed (Galli Mainini, 1947; Figueroa Casas et al., 1947; Pou de Santiago, 1947; Houssay, 1947; Pinto and Suer Boero, 1947; Blanchard and Bretto, 1947; Ferrari et al., 1947; Gandolfo and Sauri, 1947; Gori, 1947; Hutz, 1947; Mello, 1947; Merchante, 1947; Sala et al., 1947; Rodríguez Lopez, 1947; etc.).

Bidder's organ is a rudimentary ovary, situated on the anterior part of the testis, which atrophies after hypophysectomy. It becomes hypertrophied after the injection of pars distalis, or after total or subtotal extirpation of the testis; but not if the animal has been hypophysectomized (Houssay and Lascano Gonzalez, 1930, 1931).

Metabolic Functions

After the sexual season at the beginning of spring, toads feed throughout the spring and summer. In the fall they leave off feeding and fast throughout the winter, living in holes in the ground. The weight and chemical composition of their organs suffer marked seasonal variations. These have been studied in the liver (Mazzocco, 1938), muscle (Mazzocco, 1938), heart (Mazzocco, 1938), ovaries and testes (Mazzocco, (1940), fat bodies (Mazzocco, 1940; Orías and Allende, 1943), and blood (Varela and Sellarés, 1938; Gerschman, 1943).

During summer the animal feeds abundantly and all the fat reserves increase, specially in the fat bodies and in the liver. During the winter fast they decrease. In the liver, fat, protein, and mineral substances increase in summer and decrease in winter, in which season there is a relative, although not an absolute increase in glycogen.

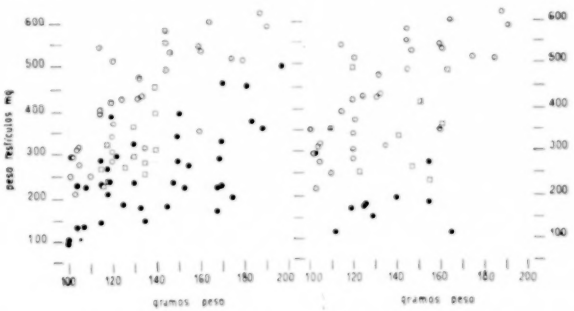

FIG. 8. WEIGHT OF TESTS OF BUFO ARENARUM HENSEL

Solid circles, hypophysectomized; open circles, controls recently captured; open squares, controls kept fasting the same length of time as the hypophysectomized toads. Left, after fasting 38 to 45 days. Right, after fasting 48 to 58 days. Abscissa, body weight in grams. Ordinate, weight of tests in milligrams.

At the beginning of spring (sexual season) hepatic, muscle, and cardiac glycogen and the blood sugar diminish. During summer, the blood sugar rises and cardiac glycogen increases a little. In winter, hepatic and muscle glycogen increase, and the blood sugar and cardiac glycogen decrease. Seasonal changes are more marked in the liver than in the muscle or the heart.

The testes reach their maximum weight at the end of the fall and the ovaries at the end of winter. During the sexual season, at the beginning of spring, if there has been copulation, there is considerable loss of weight of the gonads, specially of the ovary. Afterwards, weight is recovered, at first rapidly, then more gradually.

Oxygen consumption. Oxygen consumption does not diminish in hypophysectomized toads until there is marked asthenia (data obtained by Artundo published by Houssay and Giusti, 1929); it has not been determined at different environmental temperatures nor at different periods after hypophysectomy.

Blood sugar. The blood sugar falls progressively after extirpation of the pars distalis (Houssay Mazzocco, and Rietti, 1925a; Houssay and Biasotti' 1930; Houssay Di Benedetto, and Mazzocco, 1933; Dosne, 1943; Riet Correa, 1945); the injection of pars distalis prevents this fall, or raises the blood sugar level, but not to the normal figure. On the other hand, even high doses of pars distalis (40 lobes in one dose or 54 lobes in two days) only produce a slight increase in the blood sugar of normal toads with intact pancreas (Houssay, Biasotti, and Rietti, 1933; Dosne, 1943).

Two weeks after removal of the pars distalis the hyperglycemic response to adrenaline and to morphine is diminished. Injection of pars distalis reestablishes a normal response in hypophysectomized toads and increases the response of normal toads (Houssay and Di Benedetto, 1932; Houssay and Gerschman, 1947). The injection of the neurointermediate lobe is not so active as that of pars distalis.

The blood sugar curve following injection of glucose in hypophysectomized toads is similar to that in the controls (Riet Correa, 1945; Houssay and Gerschman, 1947).

Absorption of glucose. Hypophysectomy does not modify the intestinal absorption of glucose and galactose (Houssay, Foglia, and Fustinoni, 1937, 1941).

Liver glycogen. In the fasting toad from which the pars distalis has been removed, liver glycogen diminishes markedly and progressively (Fig. 9) (Houssay, Mazzocco, and Rietti, 1925a; Houssay and Biasotti, 1930; Houssay, Di Benedetto, and Mazzocco, 1933; Riet Correa, 1945). Total hypophysectomy causes a slightly more marked decrease. The injection of pars distalis and in a lesser degree that of neuro-intermediate lobe, prevents or diminishes the loss of glycogen in hypophysectomized toads. The isolated liver of hypophysectomized toads liberates on perfusion less glucose than the liver of the controls; but adrenaline has a marked glycogenolytic effect on the liver of the hypophysectomized toad (Houssay and Gerschman, 1947).

Muscle glycogen. There is a decrease in muscle glycogen following hypophysectomy, which is, however, less marked than the fall in liver glycogen (Fig. 9) (Houssay, Mazzocco, and Rietti, 1925a; Houssay and Biasotti, 1930; Houssay, Di Benedetto, and Mazzocco, 1933; Dambrosi, 1937; Rebolé, 1938; Riet Correa, 1945). Injection of pars distalis prevents or attenuates this loss of glycogen. Neuro-intermediate lobe has a similar but less marked effect. The resynthesis of glycogen after fatigue is sometimes retarded, but not always (Dambrosi, 1937; Riet Correa, 1945).

Cardiac glycogen. Cardiac glycogen decreases after removal of the pars distalis. Implantation of pars distalis prevents this fall (Fig. 10) (Orías, 1934; Riet Correa, 1945).

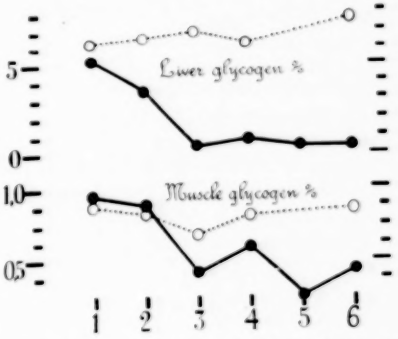

FIG. 9. DECREASE IN LIVER AND MUSCLE GLYCOGEN IN BUFO ARENARUM HENSEL

Values in grams per cent. Unbroken line, after removal of pars distalis. Broken line, controls. Time in weeks.

Sensitiveness to insulin. Toads deprived of the pars distalis are more sensitive than the controls to the blood-sugar-lowering and toxic effects of insulin (Houssay, Mazzocco, and Rietti, 1925a; Houssay and Potick, 1929). Injection of pars distalis and to a lesser degree that of neuro-intermediate lobe corrects this hypersensitiveness (Houssay and Potick, 1929). This was the first fact observed which showed the author that the pars distalis plays an important part in carbohydrate metabolism.

Role of the hypophysis in pancreatic diabetes. Extirpation of the hypophysis or of the pars distalis diminishes markedly the severity of the course of diabetes produced by pancreatectomy (Table 1). Implantation or injection of the pars

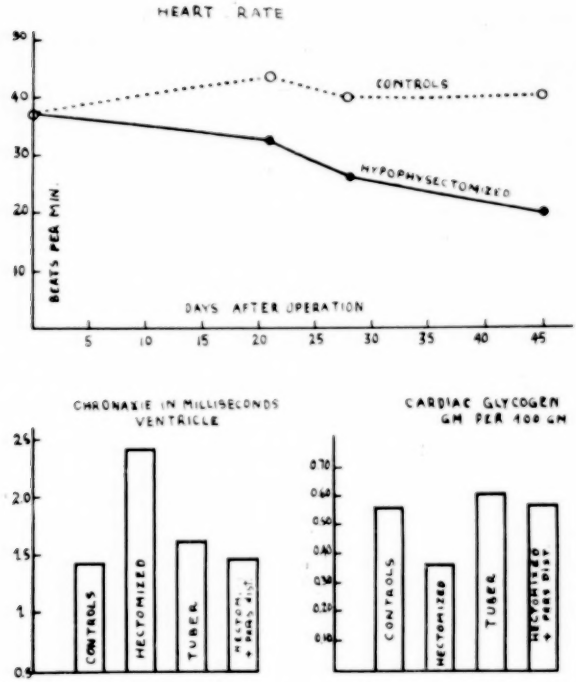

FIG. 10. CARDIAC CHANGES IN BUFO ARENARUM HENSEL AFTER REMOVAL AND INJECTION OF PARS DISTALIS
After removal of pars distalis, *hypophysectomized* or *hectomized*. After injection of pars distalis, *pars dist.* (From Orías, 1934.)

distalis reestablishes the usual severity of pancreatic diabetes or even increases it. The neurointermediate lobe is much less potent in this respect, and several tissues of toads or mammals which have been assayed have no activity in this respect (Houssay and Biasotti, 1930, 1931, 1933, 1936; Biasotti, 1930; Campos, Curutchet, and Lanari, 1933; Houssay, Biasotti, and Sammartino, 1935; Houssay and Leloir, 1935). Hypophysectomy attenuates the pancreatic diabetes in several batrachians and reptiles (Houssay and Biasotti, 1933) and in the fish *Mustelus canis* (Orías, 1932). With implantation of pars distalis, the diabetes recovers its intensity.

These facts gave the first demonstration (1929–30) of the diabetogenic effect of the pars distalis. The diabetogenic action of the hypophysis in the hypophysectomized and pancreatectomized toad has been obtained with the hypophysis of many vertebrates (Houssay and Biasotti, 1931, 1933,

TABLE 1

Glycemia in the toad Bufo arenarum Hensel
Averages of many experiments
Values in mg. per 100 cc.

	NORMALS	CRANEOTOMIZED	HYPOPHYSECTOMIZED	WITHOUT PARS DISTALIS	TUBER LESION
With pancreas	64	64	51	56	57
Implantation of pars distalis	68	69	58	69	60
Pancreatectomized	199	169	94	94	127
Pancreatectomized, implantation of pars distalis	256	278	228	214	234
Pancreatectomized, implantation of neurointermediate lobe	199	166	110	116	146

1938; Houssay, Smyth, Foglia, and Houssay, 1941; A. Houssay, 1945). Conversely, the toad hypophysis has a diabetogenic action on mammals (Foglia, 1940, 1941; Houssay, Smyth, Foglia, and Houssay, 1941).

The diabetogenic action of the hypophysis has been obtained after the removal of many organs, e.g., brain, thyroid, gonads, etc. A hypophyseal diabetogenic effect is not obtained even with high doses if the animal has its pancreas intact. On the other hand, small doses have an intense effect in the pancreatectomized-hypophysectomized toads.

The diabetogenic effect cannot be obtained after total hepatectomy (Campos, Curutchet, and Lanari, 1933), and its intensity diminishes proportionately to the amount of liver removed (Foglia, 1942). Adrenalectomy also diminishes the severity of pancreatic diabetes (Houssay and Biasotti, 1936; Dosne, 1943). In toads which have had the adrenals, hypophysis, and pancreas removed, the pars distalis has a diabetogenic effect, but sometimes it is less marked than in the hypophysectomized-pancreatectomized toads (Houssay and Biasotti, 1936; Houssay and Leloir, 1935; Dosne, 1943).

The diabetogenic potency of the hypophysis of several species has been assayed in hypophysectomized-pancreatectomized toads (Houssay, Smyth, Foglia, and Houssay, 1941; Houssay, 1945). Growth hormones and adrenocorticotrophin of mammals have a diabetogenic effect (Houssay, 1945). Large doses of alloxan diminish the hypophyseal diabetogenic action and lower the blood sugar of pancreatectomized toads (Houssay, Houssay, and Sara, 1945). Perfusion of the isolated livers of normal and hypophysectomized toads with a solution of alloxan diminishes glycogenolysis (Houssay and Gerschman, 1947).

Phloridzin diabetes. Phloridzin produces little or no glycosuria in hypophysectomized toads, but causes an intense hypoglycemia and high mortality. Injection of pars distalis to hypophysectomized toads treated with phloridzin diminishes the intensity of hypoglycemia and increases glycosuria (Di Benedetto, 1931).

Nitrogenous metabolism. The hypophysectomized toad has a low elimination of nitrogen during fasting, which may be 30 per cent less than that of controls. Implantation of pars distalis then increases the excretion of nitrogen (Braier, 1933).

Mineral metabolism. After hypophysectomy there is a progressive decrease in concentration in the plasma of magnesium (44%), of calcium (32%), of phosphates (26%), of sodium (20%), of chloride (11%), and of potassium (6%) (Gerschman, 1943). Sodium concentration diminishes in muscle; and potassium concentration diminishes in the liver (Cicardo, 1944).

General Symptoms

Metabolic disturbances caused by the removal of the hypophysis or of the pars distalis, and the anatomical and functional effects of these operations, produce many, varied, and severe symptoms.

Hypophyseal asthenia. Two or three weeks after the removal of the hypophysis or the pars distalis, progressive asthenia sets in, and death occurs within a few days (Giusti and Houssay, 1924; Houssay and Giusti, 1929, 1930; Houssay, 1933, 1936; Cicardo, 1935; Marenzi, 1936; Fustinoni, 1938). This asthenia is more prolonged and intense than the asthenia observed in adrenalectomized toads, which lasts only a few hours.

Postural disturbances are the first symptoms to appear: 1) the toad has difficulty in righting itself when laid on its back; later it completely loses its postural reflexes (Fig. 11); 2) the head and limbs are not held in the normal erect position; 3) reflexes are easily fatigued; 4) the slowness of movement and weakness becomes more and more marked as time passes; the croaking reflex disappears; the animals remain motionless and slightly rigid; and finally they die; 5) in 5 to 15 per cent of the animals convulsions are observed.

In muscle the following chemical disturbances are seen to take place slowly and progressively: decrease in glycogen (Fig. 9), phosphates and phosphocreatine (Fig. 12); in hepatic and muscle glutathione (Marenzi, 1933, 1934, 1936); basal lactic acid is normal, but during muscular activity it increases less than in the controls (Marenzi, 1934, 1936; Rebolé, 1938). Fatigue curves of muscles of hypophysectomized toads give 75 to 80 per cent of the normal amount of work (Houssay and Giusti, 1929; Houssay, 1933). There are no changes in the chronaxies of motor nerve or muscle, except in the final stages when there is very pronounced asthenia (Cicardo, 1936). The injection of mammalian and toad pars distalis has a

preventive and a partially curative effect on the chemical disturbances in muscle and on asthenia.

The chemical changes in the central nervous system have not been studied. The speed of conduction in the sciatic nerve of hypophysectomized animals is slightly below normal, at all

vented or improved by the administration of pars distalis. The electrocardiogram shows: a) a broadening of P, R, and B (bulbus aorticus); b) the outline of P is abnormal, R shows splintering, and an S deflection appears; c) R is low and T very wide (Arrighi, 1941). The frequency of contrac-

FIG. 11. ASTHENIA IN BUFO ARENARUM HENSEL FOLLOWING REMOVAL OF THE PARS DISTALIS
The toads do not recover normal posture after being laid on their backs; catatonic position. (From Houssay 1933.)

temperatures (Odoriz, 1941). The fundamental cause of asthenia is to be found in the disturbances of the central nervous system, more than in peripheral changes. In hypophysectomized asthenic toads the rheobase of afferent nerves is increased, as judged by the reflex response. Reflexes are easily fatigued and later some cannot be obtained (Cicardo, 1936).

Circulatory symptoms. After hypophysectomy, the following symptoms appear gradually (Orías, 1934; Cicardo, 1935): a) bradycardia; b) decrease in heart glycogen; c) increase in the chronaxie of the myocardium (Fig. 10); d) sometimes a diminution in the excitability of the vagus, owing to cardiac disturbances. These alterations are pre-

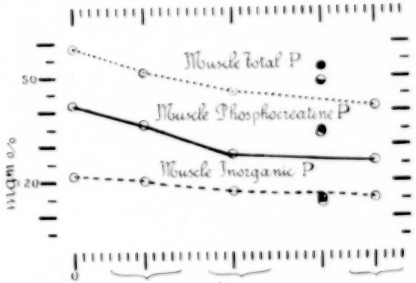

FIG. 12. PROGRESSIVE DECREASES IN MUSCLE PHOSPHORUS IN BUFO ARENARUM HENSEL AFTER REMOVAL OF THE HYPOPHYSIS OR PARS DISTALIS. (From Marenzi, 1933, 1934)

tion of the lymphatic hearts is decreased (Foglia and Braun Menendez, unpublished).

In the asthenic state the blood pressure falls slightly, but this occurs later and is less marked than in animals in which the neuro-intermediate lobe has been extirpated (Orías, 1934) (Fig. 6).

Changes in the blood. The decrease in the tone of arterioles and capillaries produced by removal of the neuro-intermediate lobe causes hydremia and changes in the mineral content of the plasma, as described above (see mineral metabolism). There is a decrease in plasma proteins, more marked for serum albumin than for serum globulin. Non-protein nitrogen also diminishes (Goldberg, 1938).

In blood collected from the heart or the aorta the erythrocyte and hemoglobin concentration is found to be diminished. The red cells are found in the small peripheral vessels and capillaries in increased concentration. There is leucopenia, granulocytopenia, and a decrease in the eosinophils. There is a normal concentration of lymphocytes and a slight increase in the basophils (Varela and Sellarés, 1934; Parodi, 1937).

Gastro-intestinal disturbances. Toads, after removal of the anterior lobe of the hypophysis, when in asthenia (at the stage when they do not return immediately to a normal posture after being laid on the back) have gastro-intestinal paresia. The intestine has a diameter two to three times that of the controls, and the distal half is filled by a light green fluid. The gastro-intestinal blood vessels are greatly dilated. In some cases the mucosa of the duodenum is of a deep blood-red color, due to intense congestion (Houssay, Foglia, and Fustinoni, 1937, 1941).

Cutaneous symptoms. In hypophysectomized toads and also in those deprived of the pars distalis, a thick horny layer, adherent to the skin, is formed (Giusti and Houssay, 1921, 1922, 1923, 1924; Puente, 1927; Houssay and Giusti, 1929, 1930; Ungar, 1932; Houssay, 1934, 1936; Aubrun, 1935; Porto, 1936) (Fig. 4). This is covered by a dark brown or bronze coloured cuticle, due to an exaggerated production of the horny layers which are not shed.

Puente (1927) and Porto (1936) have studied the histological changes that occur. The secretion of the cutaneous glands diminishes considerably (Aubrun, 1934, 1935; Porto, 1936). The cuticle can be taken off by friction and the denuded skin is very sensitive to acids (Houssay and Giusti, 1929; Aubrun, 1935).

In *Bufo arenarum* Hensel thyroidectomy does not provoke the formation of a horny cuticle; but it is not known whether or not there are accessory thyroids. Thyroxine provokes shedding of the horny cuticle.

The injection of mammalian or toad pars distalis prevents the formation of the horny cuticle in hypophysectomized toads; and if already formed it is shed. The pars distalis of the hypophysis controls the shedding of the skin (Ungar, 1932; Aubrun, 1935).

Cutaneous ulcers are seen on the limbs, mouth, and around the eyes and nose (Houssay and Giusti, 1929; Porto, 1936; Houssay, 1936).

Resistance to infection and intoxication. Wounds in hypophysectomized toads are easily infected and heal slowly. Two to three weeks after hypophysectomy toads become very sensitive to trauma, and operations which are well resisted by normal animals cause a high mortality (Magdalena, 1934; Aubrun, 1935; Pasqualini, 1935; Houssay, 1936). The cutaneous glands are invaded by cocci (Aubrun and Porto, cit. by Houssay, 1936).

Hypophysectomy does not modify the sensitiveness of *Leptodactylus ocellatus* to the toxic action of veratrine (Houssay, 1910) nor that of the toad to several toxic substances (Giusti, 1921) or to the convulsive action of cardiazol (Cicardo, 1943). On the other hand, total hypophysectomy or removal of the pars distalis alone increases the sensitiveness of *Bufo arenarum* to insulin (Houssay, Mazzocco, and Rietti, 1925; Houssay and Potick, 1929), to trypan blue (De Robertis, 1939), to water intoxication (Gerschman, 1943), to potassium (Cicardo, 1944), to strychnine (Penhos, 1943), to caffeine (Penhos, 1946), and to glucose (Riet Correa, 1945).

Infundibulo-tuberal Symptoms

The only purely diencephalic symptom produced by burning the infundibulo-tuberal region with a hot needle or a galvano-cautery is the sexual clasping produced in a large number of the males, even after hypophysectomy or castration (Houssay and Giusti, 1930).

Infundibulo-hypophyseal Effects

Hypophyseal symptoms produced by injuring the tuberal region. If the infundibulo-tuberal surface is injured there are disturbances in the hypophysis. In the first place, the circulation on its ventral surface stops and later an infarct is formed in the

center of the distal lobe (Fig. 3), reaching its maximum development in 7 days, lasting 11 to 17 days, till finally regeneration takes place in 25 to 35 days. First chromophobe and later chromophil cells appear (Houssay and Giusti, 1930b; Lascano Gonzalez, 1935). As a result of this process, there is at first increased reabsorption of glandular products, followed later by a prolonged inhibition of hypophyseal functions (Houssay, Biasotti, and Sammartino, 1935).

The initial increase of reabsorption causes:

a) *Transient darkening of the skin* (Giusti and Houssay, 1924; Houssay, Giusti, and Goñalons, 1925; Houssay, Mazzocco, and Rietti, 1925; Houssay, Mazzocco, and Sammartino, 1935) due to the dispersion of the melanosomes in the melanocytes, and lasting one to three days. It does not take place if the neuro-intermediate lobe has been removed.

b) *Ovulation and oviposition* (Giusti and Houssay, 1922, 1923, 1924; Houssay, 1923, 1926, 1936, 1947; Houssay and Giusti, 1930; Houssay, Biasotti, and Sammartino, 1935) observed in 20 to 80 per cent of the females, but not if the pars distalis has been removed.

c) *Release and expulsion of spermatozoa*, observed in a certain percentage of males; but not if the pars distalis has been removed (Houssay, 1947).

d) *Polyuria*, transient and not always observed. It is due to neuro-intermediate lobe insufficiency (Houssay, Giusti, and Goñalons, 1925; Pasqualini, 1935, 1938).

e) *Thickening and adherence of the horny layer of the skin* in 15 to 60 per cent of the animals. It is corrected by injection of pars distalis (Giusti and Houssay, 1922, 1923, 1924; Houssay and Giusti, 1929, 1930; Houssay, Biasotti, and Sammartino, 1935; Aubrun, 1934, 1935).

f) *Partial inhibition of pancreatic diabetes* (Table 1) (Houssay and Biasotti, 1930, 1931; Houssay, Biasotti, and Sammartino, 1935) *or phloridzin diabetes* (Di Benedetto, 1932), usually less marked than in hypophysectomized animals. When implanted, the hypophysis of toads with a tuberal lesion has its usual diabetogenic activity, and the gonadotrophic effect is only slightly diminished, but in situ it does not function normally.

g) *Asthenia* occurs in only 10 to 15 per cent of the animals (Houssay, 1933, 1936; Houssay, Biasotti, and Sammartino, 1935).

Other symptoms of hypofunction of the pars distalis are observed in some cases: slight flattening of the thyroid epithelium (Magdalena, 1932, 1933); slight, inconstant lowering of the blood sugar (Houssay, Mazzocco, and Rietti, 1925; Houssay and Biasotti, 1930; Houssay, 1936; A. Houssay, 1943); slight cardiac changes (Orías, 1934); small, irregular changes in capillaries (Aubrun and Porto, 1934; Aubrun, 1935) and in blood pressure, which is sometimes above and sometimes below the normal (Orías, 1934). The testes (Giusti and Houssay, 1924; Houssay and Lascano Gonzalez, 1929), the hemoglobin content of blood (Parodi, 1937), and liver and muscle glycogen (Houssay, Mazzocco, and Rietti, 1925; Houssay and Biasotti, 1930) are normal.

The effect of the nervous system on hypophyseal functions. Sexual clasping causes the pars distalis to secrete gonadotrophins, which erotize the male and provoke the release and explusion of spermatozoa; in the female there is ovulation and oviposition. Ovulation does not occur in females when clasped by males if the pars distalis has been extirpated (Houssay, 1934, 1936, 1937). The mechanism by which the nervous system acts on the pars distalis is not known.

The nervous system controls the secretion of the melanosome-dispersing hormone of the neuro-intermediate lobe of the hypophysis and of adrenaline by the adrenal medulla. The melanosome-dispersing hormone darkens the skin by dispersing the melanosomes; adrenaline concentrates the pigment and therefore lightens the skin (Stoppani, 1941, 1942). The suppression of light darkens the skin. Stimulation of the optic nerve or of the infundibulum lightens it (Stoppani, 1941, 1942).

HYPOPHYSEAL HORMONES

Although the actual hormones have not been isolated, an analysis of the symptoms of insufficiency, restitution, and hyperactivity of the hypophysis shows that probably there are many hypophyseal hormones active in the toad.

The neurohypophysis produces a *vasotonic hormone* which contracts the arterioles and capillaries; an *oliguric hormone* which controls the reabsorption of water by the renal tubes; an *oxytocic action*; an *effect on water metabolism;* and to a lesser degree than the principal lobe it has a regulatory action on carbohydrate metabolism. Perhaps the vasotonic and oliguric actions are due to a single hormone.

The intermediate part produces the melanosome-dispersing hormone, which controls the distribution of pigment in the skin and retina.

The pars distalis has the following effects: *gonadotrophic*, *thyrotrophic*, *corticoadrenotrophic*, and *on the skin*, which are not common to other parts of the hypophysis. In common with the other lobe, but of much greater importance, are its regulatory effects on *carbohydrate metabolism* and on *growth*. It also has some pharmacological effect on the melanosomes, but it is less active in that respect than the pars intermedia. It has a slight vasotonic action, less important than that of the neurohypophysis.

The toad hypophysis has several effects on mammals: the neuro-intermediate lobe has slight hypertensive and oxytocic effects. Houssay, Giusti, and Lascano Gonzalez (1929) found 0.001 I U of oxytocic action per mg. in the distal lobe and 0.042 I U per mg. in the neuro-intermediate lobe, i.e., one-fifth the activity of the posterior lobe of bovine hypophysis. The oliguric effect has not been measured.

The pars distalis has the following effects on mammals: a) a *diabetogenic* effect three to five times greater than that of the anterior lobe of bovine hypophysis (Foglia, 1940, 1942; Houssay, Smyth, Foglia, and Houssay, 1941; A. Houssay, 1945); b) a marked effect on *growth* (Foglia, 1940, 1942). One distal lobe contains 0.5 Collip units, i.e., 150 U per g. of fresh lobe; c) well marked *thyrotrophic* (Magdalena, 1932; Houssay, Novelli, and Sammartino, 1932; Foglia, 1940, 1942), and *adrenotrophic* (Foglia, 1940, 1942) effects, 0.33 adrenotrophin Collip units per lobe, i.e., 100 U per g.; d) stimulation of *growth of thymus and spleen* (Foglia, 1940, 1942); e) a weak lactogenic effect; f) *potentiation of the gonadotrophic* effect of urine of pregnant women (Foglia, 1940, 1942), but without appreciable gonadotrophic effect when given alone (Del Castillo and Novelli, 1937).

Hypophyseal hormones found in the blood. The following hormones have been demonstrated in the blood of the toad:

a) the *melanosome-dispersing hormone* (Stoppani, 1941, 1942);

b) the *vasotonic hormone* (doubtful demonstration by Neubach, 1937);

c) the *gonadotrophic hormone* (exceptionally) (Houssay, 1947).

This question must be subjected to further study, concentrating and isolating the hormones in the plasma.

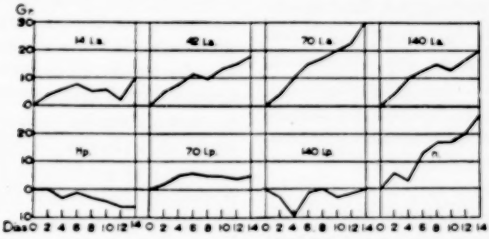

FIG. 13. CHANGES IN WEIGHT OF LOTS OF 100 G. HYPOPHYSECTOMIZED FEMALE RATS AFTER INJECTION OF FRESH PARS DISTALIS FROM BUFO ARENARUM HENSEL

Upper curves: after injection of fresh pars distalis. In the course of 14 days, injections respectively of 14 lobes (3 mg.), 42 lobes (10 mg.), 70 lobes (15 mg.), and 140 lobes (33 mg.). Lower curves: Hp, hypophysectomized, non-injected controls; 70 l.p. and 140 l.p., injection of 70 (10 mg.) and 140 (21 mg.) neuro-intermediate lobes respectively; n, normal untreated controls. (From Foglia, 1940 and 1941.)

SUMMARY

The hypophysis of the toad is an organ of great importance, as it fulfills functions *necessary for the maintenance of the life of the individual*, and for sexual and reproductive functions which are *necessary for the maintenance of the species*. It is the central organ of the endocrine constellation, necessary for the development and maintenance of the other endocrine glands. It is principally an organ which regulates important metabolic functions.

A) The *pars intermedia* controls several functions. It maintains the normal color of the skin, with its physiological changes and responses to drugs, by adequate dispersion of the melanosomes. Its secretion is regulated by reflexes, therefore by the central nervous system. It regulates the expansion of the pigment of the retina in response to light.

B) The *neurohypophysis* governs the following functions: a) it maintains the tone of arterioles and capillaries, thus playing an important part in the maintenance of arterial blood pressure and in the distribution of erythrocytes and plasma in the different parts of the body; b) it regulates water metabolism, first by controlling the reabsorption of water by the renal tubes; and secondly by controlling the movement of water through the skin and other tissues.

C) The *pars distalis* (distal lobe) of the hypophysis has endocrine regulation and metabolic functions of vital importance for the individual and the species. It controls:

a) the development and maintenance of the thyroid, the adrenals, the gonads (including Bidder's organ) and is necessary for compensatory hypertrophy of these glands;

b) the development of the gonads and sexual characters, erotization and fertilization, release and expulsion of spermatozoa and eggs during sexual clasping are due to hypersecretion of gonadotrophins, stimulated reflexly by the sexual act;

c) the development of the thyroid necessary for metamorphosis of larvae into the adult form (the effect on growth has not yet been studied in this species);

d) metabolic functions of great importance (carbohydrate and protein metabolism, etc.), disturbance of which causes progressive asthenia and death in 3 to 8 weeks in the majority of hypophysectomized animals; central nervous system, heart, muscles, etc., are affected by these disturbances;

e) regulation of the casting of the skin (the formation and shedding of the horny layer) and of cutaneous glandular secretion;

f) resistance to trauma, infection, intoxication and hypoglycemic and hypotensive agents.

Injury of the *tuber cinereum* produces ischemic necrotic lesions in the pars distalis of the hypophysis with initial glandular reabsorption and later a more or less marked state of hypophyseal insufficiency.

Not all these functions have been observed in mammals, but in many cases a function found in the toad has afterwards been observed in mammals. For this reason the author has first studied each function in the toad and simultaneously, or later, in more complex animals. The comparative study of endocrine functions in several widely different animals leads to a clearer understanding of their mechanism and significance. No student of the endocrine function of the hypophysis can ignore the valuable results obtained in the toad, and all will feel grateful to this humble species for the many secrets of such an important organ it has revealed to us.

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PERSISTENT PROBLEMS IN THE EVOLUTION OF MIND

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THE comparative psychologist must try to ask questions of his animals and to understand their answers. When Pfungst (1911) demonstrated that the horses of Elberfeld, who were showing marvelous linguistic and mathematical ability, were merely reacting to movements of the trainer's head, Mr. Krall, (1912), their owner, met the criticism in the most direct manner. He asked the horses whether they could see such small movements and in answer they spelled out an emphatic "NO." Unfortunately, we cannot all be so sure that our questions are understood or obtain such clear answers. In 1913 Szymanski tried to find out whether the dog can recognize pictures of objects. The dogs not only failed to recognize the pictures but even failed to distinguish the objects. After long testing with the best methods that he could devise, Szymanski concluded that the dog's vision is so poor that he can only distinguish light from darkness. A number of us in this country were equally unsuccessful in demonstrating detail vision in dogs and rodents. For a period of ten years we were forced to believe these animals practically blind, in spite of common experience to the contrary. Then by chance we hit upon the method of having the animal jump against the objects to be distinguished. This "look before you leap" method put the questions in a way that was intelligible even to rats. They learned in 1 trial discriminative reactions that had formerely taken more than 100; they learned in 10 trials, tasks that they had previously failed after 7000 trials of training. Except for differences in acuity, their perception of visual form turned out to be almost as good as my own. Dogs did equally well. Evidently when an animal fails in a task, it is not safe to conclude that he lacks capacity for that task, unless we can be sure that the question was properly asked.

Sometimes the answers are unexpected and often ambiguous. When I started work with chimpanzees, I presented what seemed a very simple problem: to associate a white box with food. I placed a white and a black box on a table before the cage, each box attached to a rope extending to the bars of the cage. The white box alone always contained food and if the black box were pulled in, I snatched away the other rope. When this had happened half a dozen times, my subject, Mimi, a husky female, grasped a rope in each hand, pulled one in until she could wrap it around her foot for a firm grip. She thus freed both hands to pull in one rope, while retaining complete control of the other. If the first box were empty, she usually won the tug of war for the second. Her solution of the problem was better than my own, so I judge it highly intelligent. But when I finally regained control of the situation, Mimi took more than 200 trials to form the simple association between the white box and food, a task which the rat, under optimal conditions, can learn in a single trial.

I describe these misadventures in animal training to emphasize the tentative character of the conclusions to be drawn from the accumulated mass of studies of animal behavior. It has been said that American rats learn only by trial and error, whereas European rats learn by insight. Certainly, investigators in America have been only too prone to put a rat in a dark box where it can do nothing but press a lever and, because it does nothing else, to conclude that all its behavior is of the same character. Unless the experimenter has wide experience with the animals that he studies and adapts his questions

to their modes of behavior, the results give little information about their true capacities. There are remarkably few comparative studies which are really significant for the evolution of behavior. A great part are meaningless for the problem, either because the questions were improperly put or because the tests were made with a single species and comparable data are available for no other. In consequence, the evolution of mind can as yet be sketched in only the most general terms, with no certainty that the actual level of development of any species has been determined, and with comparative data on but few functions.

THE ORIGIN OF MIND

The study of mental evolution has been handicapped by a metaphysical dualism. Early students were concerned with the question of where mind or consciousness first appears among animals. They accepted the Cartesian distinction between mind and body and felt it necessary to trace the evolution of conscious states along with the evolution of the brain and of behavior. Various criteria of mind were proposed, the most familiar being "associative memory," emphasized by Jacques Loeb, but none was satisfactory and many students turned away from the problem as insoluble.

Behaviorism met the issue by denying that the conception of mind has any definite meaning. The first statements of this position were not rigorously formulated, and behaviorism has been assailed for denying self-evident facts of experience, whereas the denial was that the facts constitute evidence for a meaningful distinction between experience and behavior. The position of behaviorism can be stated more rigorously today, largely as the result of the application of operational concepts as tools of logical criticism (Lashley, 1923; Stevens, 1936; Boring, 1946).

Subjective experience reveals only a complex of activity, varying from moment to moment, without constant structure or content. The characteristic is the organization. The organizing process is not experienced; that is, thoughts think themselves, just as the words of a sentence fall spontaneously into grammatical order. The elements which are organized, sensations, feelings, etc., cannot be described or defined. They are abstractions from the mental structure which have in themselves no attributes distinguishing them from physical abstractions. I shall not attempt here to validate this statement beyond pointing out that William McDougal (1913), the most aggressive recent advocate of mind-body dualism, was forced to postulate atoms of mind-stuff, adsorbed on physical atoms, as the elements of mental structure. The question of what may happen to such mental atoms in these days of atomic fission was not foreseen when he wrote in 1913.

Psychological analysis reveals nothing but varying organization or structure. Studies of the physiology of the nervous system and analysis of behavior reveal the same principles of organization as are discovered by subjective analysis (Lashley, 1941b). The question, "what is the mental state of an animal?" means then: what is the level of organization of its activities? The question can have no other meaning because no other conception of mind can be derived from experience.

I should not have burdened you with this matter, save that eminent biologists (e.g., Lillie, 1944; Herrick, 1945; Sherrington, 1947) still maintain that mind, where it appears, performs a unique function in integrating behavior. They have not, however, indicated the nature of this function or defined the behavior which is its unique product. They postulate two modes of biological action but do not suggest the nature of the distinction between them. Even so keen a philosophical biologist as Woodger (1929), though he insists that the concept of mind has no place in biological science, accepts the distinction between public and private knowledge, without realizing that private knowledge is, on analysis, only private ignorance. The questions of where mind or consciousness enters in the phylogenetic scale and of the nature of conscious experience as distinct from physiological processes are pseudo-problems, arising from misconceptions of the nature of the data revealed by introspection. A comparative study of the behavior of animals is a comparative study of mind, by any meaningful definition of the term.

THE NATURE OF BEHAVIORAL EVOLUTION

The interest of early students of comparative psychology was in finding the origin of human mental traits. Darwin and Romanes could point out behavior of animals which suggested similarity of emotional characters, memory, and intelligence to that of man, and could show that

the similarity increased with increasing bodily similarity to man. They could not specify what was changing in evolution or the nature of the steps between different levels of behavior. We are in a scarcely better position today. It is not possible to classify unit factors in behavior and to trace the development of distinct entities, as one may trace the evolution of the heart, the gill arches, or the limbs. For such a classification it is necessary to know the mechanisms by which the behavior is produced and to trace the evolution of these mechanisms. This is still impossible for any except the simplest and most primitive forms of behavior. The problems can, however, be defined more clearly than was possible a generation ago.

A sharp distinction has often been made between instinct and intelligence, with the implication that these represent divergent lines of evolutionary development. Instinctive behavior is described as genetically determined, stereotyped, and relatively unmodifiable; intelligent behavior as the product of experience, plastic and adaptable. Analysis of behavior included under the two categories does not, I believe, justify the distinction. The differences are in degree only, not in kind.

Intelligence is generally defined as the capacity to profit by experience, or the capacity to learn, and its evolution is described in terms of performance in situations requiring learning. This view is based on a confusion in definitions. Learning involves both the ability to form associations and also the ability to solve problems, to discover the significant relations in the situation. The typical learning curve is compounded of trial-and-error discoveries, of insight, and of memory. Under favorable conditions every animal, at least above the level of the worms, can form a simple association in a single trial. In this sense the capacity to learn was perfected early and has changed little in the course of evolution. It is not the fact of learning but what is learned that differentiates animals in the evolutionary scale. The learning of higher animals involves a perception of relations which is beyond the capacity of the lower.

As an illustration of this, compare the learning behavior of a spider monkey and a chimpanzee in a matching problem. The monkey was set the task of choosing either a red or green square according as a red or green square was shown as a model. The monkey made no improvement above chance in nearly 1000 trials (Figure 1, a). The model was then placed in contact with the color to be chosen (b). Correct choice followed within a dozen trials. With the model returned to the original position (c), there was a chance score for 600 trials. The colored models were then increased in size to form a background; the task to choose red on red, green on green (d). This was learned very quickly. With the original small model, chance scores again. With the colored grounds just making visual contact with the squares, every trial was correct (e). Breaking the visual contact by 2 mm. (f) gave chance scores again. Rotating the model to visual contact gave errorless choice (g); rotating back, chance scores. I continued training by such methods for 18,000 trials with this one monkey, but he never learned to choose the matching object. He saw the model as a pointer when it was placed in contact with the object, but a piece of white paper served equally well to indicate the choice. He saw the colored background as a signal but disregarded the color similarity, for he learned just as quickly to choose the red object on a white background and the green on a black. The relation of similarity was not grasped. The macaque can learn this task of matching, though he requires much special training. The chimpanzee grasps it quite readily.

An attempt to analyze the learning process here results in the discovery of apparently different processes. Associations with one or another aspect of the situation are formed readily, but what is associated depends upon some sort of insight into the relations of the variable elements of the situation. For the spider monkey, visual continuity seems essential. Visual objects which are not in contact are not related. For the chimpanzee this aspect of the situation is less important.

Analysis of learning or of adaptive reactions almost always gives results of this kind. Schneirla's comparison of maze learning in ants and mammals (1937) indicates qualitative differences in the maze relations to which these animals react. The modes of response of different animals are found to be based upon different types of relational organizing which are refractory to further analysis. So far as evidence is available, the capacities for these relational concepts are genetically determined. The limits of capacity

of each order of animals are set by the kinds of relations among objects that it can perceive. The development of the individual is a slow maturation of such capacities. Intelligence tests, which are selected as representative of the average capacities at different ages, are tests for the presence of relational concepts and represent a series of qualitatively different stages of development much like those illustrated from the matching behavior of the monkeys.

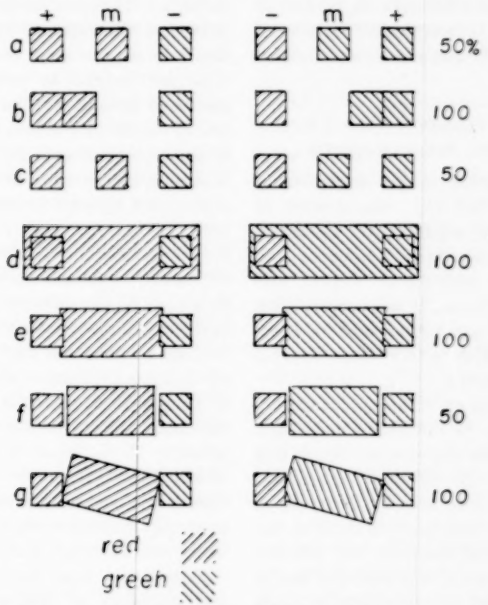

FIG. 1. RECORD OF SCORES MADE BY A SPECIMEN OF ATELES GEOFFROYI IN TRAINING TO CHOOSE ONE OF TWO COLORED SQUARES TO MATCH THE COLOR OF A MODEL (M)

The percentages given at the right represent the final level of accuracy attained in each of the seven situations.

In contrast to the usual statements, instinctive behavior is actually plastic and adaptive. Its range may be restricted by the perceptual and conceptual limitations of the organism, but within that range, the instinctive acts are directly adapted to the requirements of the situation. The web of the orb-weaver may seem, superficially, to present a stereotyped pattern but when one examines the arrangement of foundation lines, the attachment of the radii to them to produce equal spacing, or the neat repairing of the torn web, one must recognize that the construction involves an appreciation of spatial relations which is fundamentally of the same nature as the concepts of relations that are basic to intelligent behavior in man.

The mechanisms of instinctive and intelligent behavior thus seem fundamentally the same. Both are the expression of modes of the perception of relationships, and these modes are genetically determined. Higher levels of intelligence are based on a greater variety of types of organization, but this does not mean that they are any less dependent upon genetic factors.

A more important distinction for the evolution of nervous mechanisms is that between behavior mediated by anatomically restricted pathways and "relationally determined" behavior. These two types are illustrated among protozoa by the reactions of the Ciliata and Rhizopoda. In *Euplotes*, for example, the stroke of the cirri is controlled by impulses transmitted over fibers of the neuromotor apparatus (Taylor, 1920), which are limited and invariable conducting paths. In *Ameba*, on the contrary, although reaction may take place at a distance from the point of stimulation, the character of the response seems to be determined by the existing conforma-

tion of the pseudopodia, as indicated in Kepner's studies (1925) of the feeding behavior of *Ameba*. In the one case the behavior is mediated by a precise anatomic structure, and the evolutionary problem involves the accurate control of form in ontogeny; in the other, a transient physiological state is responsible for the behavior, and the ontogenetic problem is of a different character. Among higher animals this distinction appears between reactions determined by stimulation of specific receptor cells and behavior in which the *mode* of organization is genetically determined but in which the receptor and effector mechanisms are variable.

CORRELATION OF BEHAVIOR WITH THE EVOLUTION OF THE NERVOUS SYSTEM

The evolution of mind is the evolution of nervous mechanisms, but only the simpler of these can as yet be analyzed directly. Comparative studies of the brain and of behavior are, therefore, still largely separate in method and problems. I shall try to relate some of the data derived from the two approaches and to point out lines of investigation which seem to bear upon fundamental questions.

The phylogenetic history of gross changes in the nervous system can be traced in some detail. In a few cases where the relations are simple and direct it has been possible to show correlations between specific structures and behavior, as in the segmental reflexes which produce the crawling movements of the earthworm, or the relation between the dominant use of the nose as a tactile organ by the pony and the great extent of its representation in the sensory area of the cortex (Adrian, 1947). For more complicated reactions, however, such as the instinctive behavior of insects and birds or the behavior which is called intelligent, no such detailed correlations have been possible.

There are obvious changes in the gross structure of the nervous system with ascent in the evolutionary scale and these have been seized upon as the probable basis of increase in behavioral capacity. Evidence in support of such interpretations is by no means conclusive. The history of the nervous system presents a few points of radical change in structure. These points should show maximal changes in the types of activity of the animals, if gross structure is important in the reaction system. The most conspicuous of these are: the substitution of the nerve net in metazoa for the neuromotor apparatus of protista; the appearance of the synaptic type of conduction in echinoderms; the development of the dorsal nerve cord and its dominance over the ventral ganglionic chain; and the appearance of the neopallium in mammals. None of these changes seems to have introduced anything new in behavior, when it first appeared. The behavior of hydra is no better coordinated than that of some of the suctoria. The synapse perhaps conferred on the nerve net the capacity for independent reflexes, but paramecium and the hypotricha have independent reflexes as well as coordinated movements of groups of cilia. The primitive vertebrates are inferior to the higher invertebrates in every behavioral capacity that has been tested. The primitive mammal with an extensive neopallium is not superior in behavior to birds like the crow or parrot. Such studies as exist do not reveal qualitative differences in behavior corresponding to radical changes in the plan of gross structure of the nervous system. It might be said that, although such changes confer no advantage at the start, they open the way for later advancement. Such a statement, however, adds in no way to an understanding of the reason for the potential limitations of any form of the nervous system. H. G. Wells has represented insect-like inhabitants of the moon as possessed of superhuman intelligence, and the neurologist can point to no characteristic of the brain structure of insects which would preclude such a development.

Since I am most familiar with the behavior and neurology of mammals, among which the differences are chiefly in those forms of behavior which are designated as intelligent, I shall confine the discussion largely to the evolution of the brain in relation to intelligence and shall try to picture the kind of change that has been responsible for this phase of the evolution of behavior.

Attempts to correlate the level of intelligence with nervous structures have been limited almost entirely to studies of mammals. Brain weight, ratio of brain to body weight, degree of fissurization, vascularity, and relative development of different lobes of the cerebrum are the chief characters that have been studied. It has been held that the associative areas of the mammalian brain have increased, relatively more than sensory and motor areas, with ascent in the evolutionary scale, but the areas have never been actually

measured. The conclusion is based upon measurements of vaguely defined lobes which do not represent functional divisions or strictly homologous parts in different species. Definition of cortical areas in terms of their cytoarchitecture might provide a better index of changes in proportions, but comparative measurements of such areas have not been made. Moreover, George Clark and I (Lashley and Clark, 1946) have found individual variations in cell structure greater than those upon which many of the areal divisions have been based. Cerebral architecture is then unreliable as an index of function. From rough measurements of actual functional areas, determined by anatomic analysis of their connections, for the rat and monkey, I question that there has been any very significant change in the relative proportions of the different functional areas of mammalian cortex in the development from rodent to primate.

The only neurological character for which a correlation with behavioral capacity in different animals is supported by significant evidence is the total mass of tissue, or rather, the index of cephalization, measured by the ratio of brain to body weight, which seems to represent the amount of brain tissue in excess of that required for transmitting impulses to and from the integrative centers (von Bonin, 1937). We must seek the clue to behavioral evolution in the number and interconnections of the nerve cells or in their biochemical characteristics, not in their gross structural arrangement.

VARIATION AND FUNCTIONAL REGULATION IN THE NERVOUS SYSTEM

An examination of the general principles upon which the nervous system is organized throws somewhat more light upon its possible mode and direction of evolution. The system is in some ways the most highly differentiated and exactly, genetically determined structure in the body. It is also in other respects the most plastic and adaptable. Each of these seemingly incongruous characters presents special problems of phylogenetic development.

The precision of organization is illustrated by the visual system of mammals. In this system there is virtually a point to point or cell to cell connection between the retina and the occipital lobes of the cerebral cortex, predetermined in growth. Nerve fibers originate in the ganglion cell layer of the retina, are relayed in the thalamus, and the connections continued to the cerebral cortex in a nearly exact reproduction of the retina. I have found in the rat that the topological arrangements of cell bodies in the thalamic nucleus and of their axon terminations in the cortex vary at most by two to three cell diameters in a nucleus containing more than 34,000 cells and not more than one cell in 100 is displaced to this extent. This precise arrangement is not simply a result of parallel growth of fibers, for the retinal fibers are distributed at random in the optic nerve and seem to undergo a complete intercrossing between the thalamic nucleus and the cortex (Lashley, 1934, 1941a). Other sensory systems seem to be as precisely arranged, though they have been studied less thoroughly.

The functioning of such systems is rigidly determined in mammals. Damage to them results in irrecoverable loss, and there is no evidence that their mode of action can be modified in any way by learning. They are also phylogenetically very old. The arrangement of the visual paths in marsupials and man is essentially the same. Such evolutionary changes as have occurred involve only increase or decrease in number and addition or loss of certain types of cells and increase in the proportion of uncrossed fibers, but without change in the basic spatial pattern.

Systems with such accurately determined connections have been regarded as the prototype of all integrative organization. The simple reflex arc has been represented as a restricted chain of connected cells transmitting impulses from sense organs to muscles without mutual interference. More complicated behavior has been interpreted as a product of the additive activity of such paths. This view of the nervous mechanism has underlain a criticism of evolution by random variation, which has been a principal argument of Lamarckians and advocates of some form of guided evolution. They have maintained that chance variation cannot account for the evolution of behavior, because organized behavior calls for correlated variation in the genetic determiners for hundreds or thousands of connections between individual cells, and the chance of such correlated variation is infinitely small.

Evidence is accumulating, however, that the principle of organization within integrative centers, such as the cerebral cortex, is entirely different from this simple chain conduction. The precise

sensory paths transmit to the central mechanisms a pattern of excitation corresponding to the spatial and temporal distribution of stimulation on the sensory surfaces. From this point neither anatomic nor physiologic evidence lends any support to the conception of restricted anatomic pathways connecting sensory and motor centers.

The evidence for this statement comes chiefly from what we have called stimulus equivalence. An illustration of this is a fact so familiar as to be generally overlooked: *Objects remain the same with innumerable changes in visual fixation.* The general principle is that reactions are to relations within the mass of stimuli—to proportions, and the like—and are independent of the excitation of particular nerve fibers. Direct experimental work on the nervous system supports this statement. Excitations from the retina are transmitted to a definite part of the cerebral cortex, the area striata, and visual integrations apparently take place within this area only. Any other part of the cerebral cortex, in the rat at least, can be destroyed without interfering with complex visual reactions. I have found that all but 2 per cent of the visual area of the rat's brain can be destroyed without affecting these types of organization, and it need not be the same 2 per cent in all cases. The integration is somehow inherent in every part of the visual area (Lashley, 1939).

How far this concept can be carried is uncertain. It seems to hold true for learned reactions as well as for innate modes of organization. When a rat has been trained in a differential visual response, any part of the cerebral cortex may be removed without destroying memory of the stimuli, so long as enough of the visual cortex remains to permit any visual reactions at all. All attempts to analyze the nervous basis of mammalian instincts, of habits, and of modes of behavior designated as intelligent have given similar results. I started experimental studies of the brain in the expectation that definite conditioned-reflex arcs could be traced from sensory to motor regions. No experimental result has ever been consistent with this expectation. One example must suffice. A number of rats were trained in a maze and long knife cuts made through the cortex and underlying fibers, dividing the brain in a great variety of ways (Fig. 2). No evidence could be obtained that these cuts affected the habit in any way, no matter what cortical areas were divided or separated by them. The capacity to form new habits was also unaffected. The best learning score in my records of several hundred animals was made by a rat with both hemispheres split from end to end. There is similar though less detailed evidence from monkeys in which the frontal or occipital lobes or motor areas have been partially isolated. In man a wound which pierces the occipital lobe may produce a blind spot without distorting the spatial relations of the remaining functional parts of the field. The visual integrations are apparently not dependent upon the direct interconnections of different parts of the visual cortex.

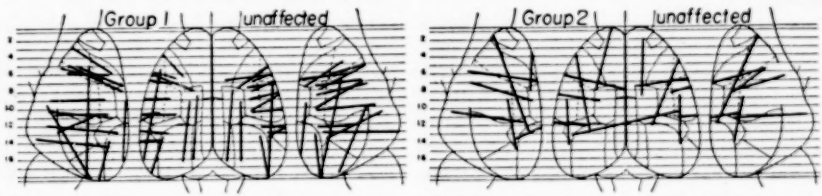

FIG. 2. COMPOSITE DIAGRAMS OF INCISIONS, PENETRATING THE FIBER LAYERS OF THE CEREBRAL CORTEX OF THE RAT, WHICH FAILED TO PRODUCE A SIGNIFICANT EFFECT UPON MAZE PERFORMANCE

Each pair of symmetrically placed lines in the two hemispheres represents the incisions in one animal. Group 1, postoperative initial learning; Group 2, postoperative retention. (After Lashley, 1944.)

I have been struck by the fact that even very extensive destruction of brain tissue does not produce a disorganization. Behavior becomes simplified but remains adaptive. In one experiment rats were trained on a latch box which required pushing down a lever, turning, and stepping on a platform to open the door to the food box. The normal animal accidentally works these latches by climbing or stepping on them. After a few trials, his behavior changes radically; he may seize the lever with his teeth and pull it

down, turn, and make a quick thrust against the platform with his fore feet. The necessary movement of the objects is somehow analyzed from the totality of chance activities, and the rat's movements are directed to manipulate the latches. Rats with large brain lesions learn this problem with about the same average practice as normal ones, but their performance is different. A rat lacking about 40 per cent of the cortical surface first opened the box by scrambling up the front of the food-box over the latch and falling off backward onto the platform. He continued this procedure throughout training, became skilful in falling and could eventually open the box more quickly than a normal animal, but he never reacted to the latches as separate objects. His reactions were organized at a simpler level, as associated movements without insight into the significance of the latches. Nevertheless, he was not confused; what was noted was associated

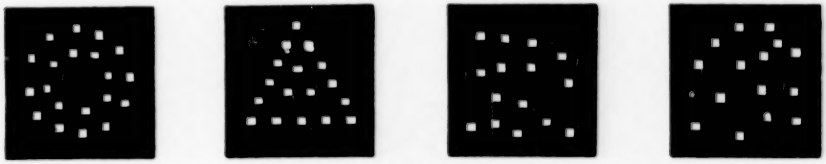

FIG. 3. STRUCTURED AND UNSTRUCTURED ARRANGEMENTS OF DOTS
Recognition of the groupings on the right is difficult for the rat, as for man.

quickly and efficiently. Uncomplicated destruction of brain tissue in man likewise does not produce confusion. Compressing tumors, diffuse disease, drugs, or traumatic shock may produce confusional states, but these agents change the chemistry of the whole system. A patient may talk coherently during and immediately after a frontal lobotomy and develop a state of confusion only as oedema develops twenty-four hours later.

A second point of major importance is that the nervous system is not a neutral medium on which learning imposes any form of organization whatever. On the contrary, it has definite predilections for certain forms of organization and imposes these upon the sensory impulses which reach it. Vision has been most adequately studied in this respect, and definite laws of visual organization have been established, which hold for all vertebrates. The animals react to objects; that is, to organized patterns of stimuli. The basic patterns of this organization are apparently inherent in the structure of the visual system. Certain patterns of excitation become units for behavior. Thus, dots arranged in simple geometrical designs are readily recognized as a definite figure. The same dots in another arrangement lose all coherence (Fig. 3). It might seem that the geometrical figures are recognized by us because they are familiar and have names. However, rats, for whom such geometrical forms cannot have acquired any meaning, learn to recognize them very quickly and are unable to distinguish the groups of randomly scattered dots after many weeks of training.

A number of laws of geometrical perception have been worked out. Coherence of the figure is determined by continuity of line or direction, continuity and contrast of surface, simplicity of outline, and the like; quantitative relations like larger, brighter, or more distant are immediately perceived. These modes of organization are innate; we have raised rats in total darkness and discover the same laws of visual organization in their first reactions when brought into the light (Lashley and Russell, 1934; Hebb, 1937). Reports of men who have first seen after removal of congenital cataract confirm these results (Senden, 1932).

In its functional organization the nervous system seems to consist of schemata or basic patterns within which new stimuli are spontaneously fitted. Even in the case of learned activities the learning may, and perhaps most frequently does involve the organization of a new generalized schema rather than the formation of a limited association. This is most clearly illustrated in the case of language. The grammatical form of each language is learned, but once it is acquired new words or new ideas are spontaneously given the structural peculiarities of the language.

The physiology of such organizations is far

from being understood, but anatomic studies suggest that a network or lattice of nerve cells forms the basis of the central integrative processes. The evidence for this comes chiefly from the work of Lorente de Nó (1933), which is epoch-making for the understanding of the action of the central nervous system. The cerebral cortex consists of a network of nerve cells connected together in circuits of different lengths. Fig. 4 shows some of the interconnections between the cells of the activity shown in the figure would be produced by a series of impulses. Actually the diagram is much oversimplified and would not produce such a result except on some improbable assumptions concerning the development of inhibition. However, it serves to illustrate the general principle of organization and the fact that a nervous network must necessarily develop its own intrinsic patterns of activity. The form of these patterns will vary with the number and reactive properties

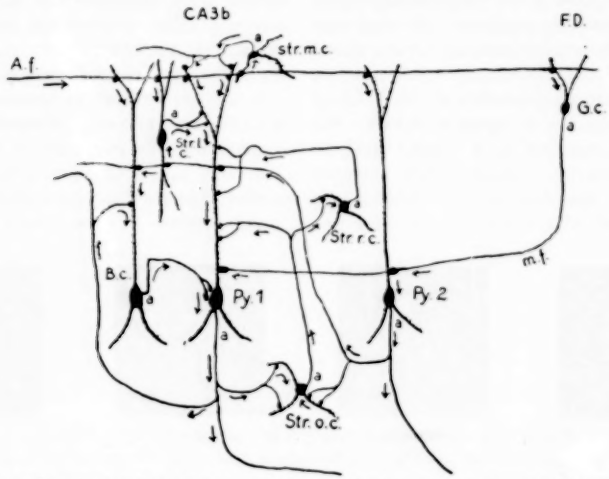

FIG. 4. CONNECTIONS BETWEEN A SINGLE AFFERENT FIBER (A.F.) AND AN EFFERENT PYRAMID (PY. 1) OF THE AMMONSHORN, ILLUSTRATING THE COMPLEXITY OF RECURRENT CONNECTIONS IN THE CORTICAL LATTICE
(After Lorente de Nó, 1934.)

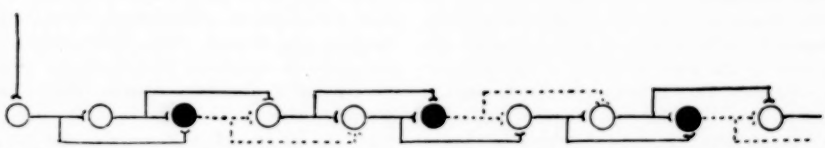

FIG. 5. DIAGRAM TO ILLUSTRATE THE PRINCIPLE OF PATTERN FORMATION IN A LATTICE OF NEURONS

cortex. An excited cell transmits impulses to adjacent cells, and the excitation may be returned from various distances, through one or a thousand links. Since the activation or inhibition of a cell is dependent upon the number and frequency of the impulses transmitted to it, it is obvious that a system so organized will have its own inherent patterns of response. Fig. 5 represents a situation where each cell is connected with two adjacent ones. If two impulses arriving in quick succession produce inhibition, the pattern of of the cells which are interconnected. I shall designate these patterns of interacting cells as neural schemata.

Different functional systems have characteristically different arrangements of cells, which appear to be fairly uniform within the system. Fig. 6 shows groups of cells from the same layer in the postcentral, temporal, and occipital areas of the monkey. In two there are a great variety of cell sizes and irregular arrangement; in the other, uniformity in size and regular arrangement

in vertical chains. There are probably corresponding differences in intercellular connections, although nothing positive is known about this.

It is not yet possible to analyze the activities of such systems in any detail. Biophysicists, under the leadership of N. Rashevsky, have made some progress toward formulation of the elementary properties of the nervous lattice (Householder and Landahl, 1945) and I have discussed possible application of the theory to the problems of stimulus equivalence and adaptive behavior (Lashley, 1942). Köhler and Wallach (1944) have approached the same problems from a consideration of the electric properties of active nerve cells and have developed a theory of field effects which provides a more explicit interpretation of some of the phenomena of perception.

not imply individual genetic determination but can arise as a product of biochemical gradients such as play a general role in the differentiation of structure. Correlations in the evolution of such systems with modifications of sense organs or limb structure follow from the general principles of morphogenesis.

Within the integrative network the variables which determine the character of organization are the number of cells forming various circuits, the amount of proliferation of axon terminations and end buds, refractory periods, and the like. These are anatomic and physiologic characters which may be common to large areas or even to the entire system. The genetic control of such characters presents a quite different problem from the determination of individual interneural con-

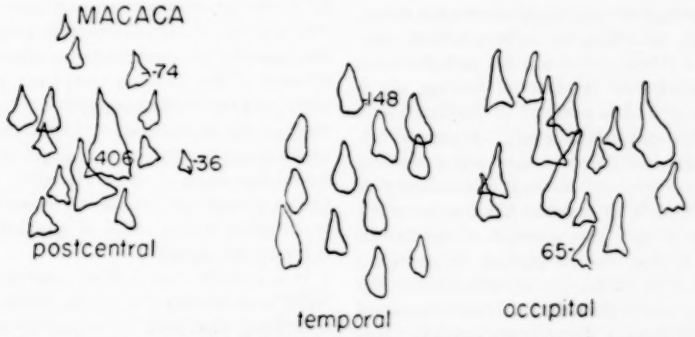

FIG. 6. THE ARRANGEMENT OF CELL BODIES IN LAMINA III IN THE POSTCENTRAL, TEMPORAL, AND OCCIPITAL REGIONS OF MACACA
(After Lashley and Clark, 1947.)

The common characteristic of all these theories of nervous integration is the recognition that a network of nerve cells has inherent properties of organization which are dependent upon the spatial and physico-chemical properties of the system as a whole. The significance of such views of nervous mechanisms for the problem of evolution is their implication concerning what is genetically determined in behavior and concerning the potentialities of the system for correlated variation and self-regulation.

Those systems which show a predetermination of intercellular connections, such as the paths from the eye to the striate cortex, have an essentially spatial organization. The relative positions of the cell bodies determine the relative positions of axon terminations. The neuron specificities do

nections. The mechanisms of their ontogeny may be no more specific than are those which control the development of dermal or other structures. Variation or mutation may change such characters, with resultant changes in the integrative patterns developed within the nervous network, but so long as the tissue retains the fundamental characters of the network, its activities will be organized according to the same general principles. Just as extensive lesions may result in a simplification of reactions without producing a disorganization, so mutations may modify the fundamental capacities or modes of integration without producing a functional disorganization, so long as a lattice of nerve cells is maintained.

APPARENT DISCONTINUITY IN THE EVOLUTION OF BEHAVIOR

The anatomist can sometimes trace the progress of evolution by quantitative changes in structure. He may see how the form of a limb or tooth has developed by changes in its proportions or by the addition, subtraction, or reduplication of identifiable elements. Such insight into the modifications of behavior is rarely if ever possible. The three types of reaction to the object presented in the matching experiment described above, as a pointer, as a signal, and as a model, seem qualitatively different. We cannot see how growth of one of these modes of responding can transform it into another. The same outcome appears in all attempts to measure quantitatively the development of any behavioral function. The measures of human intelligence consist of groups of tasks assigned to each chronological age, according as some arbitrary percentage of children of that age can pass the tests. A quantitative scale in terms of average age is thus produced and is assumed to measure something which is called intelligence. If the individual test items of different ages are compared, however, they give no evidence of continuity of growth. There is no common function in noting the absence of ears from a sketch of the human head and finding the incongruity in a logical contradiction (two different age level tests). The processes by which the different tasks are carried out seem to form a discontinuous series. This is true both of phylogenetic and ontogenetic development. Different levels of capacity are largely characterized by different types of integrative activity. Even the development of language, to which a major part of human superiority has often been ascribed, seems to be primarily the expression of forms of relational organization which are absent in lower mammals, rather than a means to such organization, as has sometimes been held.

For example, one of the most important of language activities is the use of the series of ordinal numbers. Almost all mathematical procedures depend upon it. The ordinal numbers involve the matching of two arrays of objects and the recognition of their common property of serial order. This can be done to some extent at least without language, as when a child sets up two parallel rows of matching blocks. It is not the invention of the symbols which makes possible the function, but the extension of the capacity for matching objects, shown by the chimpanzee, to the more abstract concept of arrangement. The chimpanzee, or even the rat, can learn the order of a single series, but no animal has given any evidence of the generalization of the order of one set of objects to another. Without such generalization the conception of number and the development of number-names is impossible.

In contrast to the apparently discrete qualitative changes in the kinds of integration involved in performance of different tasks at different levels in the evolutionary scale, the growth of the nervous system presents a continuous quantitative change. As I pointed out earlier, the only established structural correlate with evolution in complexity of behavior is based upon brain weight. In a number of experiments I have found that the severity of deterioration is proportional to the quantity of cerebral tissue destroyed. Cell division in the brain is completed in the early years, and the intellectual growth of the individual must be due to maturation of cells, expressed as a proliferation of axons or as changes in the physiological characters of the nerve cells. In all these cases a quantitative change in nervous tissue seems to correlate with a series of qualitative changes in behavioral capacity.

It is possible that a more penetrating psychological analysis may discover the common processes underlying what seem to be qualitative diversities in the organization of behavior, and so reveal a quantitative continuity of behavioral development. Students of genetic psychology have frequently assumed that mental development is a continuous quantitative growth. Spearman (1923), for example, has equated intelligence with the level of an hypothetical mental energy. Thorndike (1926) has suggested that it depends upon the number of potential associative bonds which have not yet been preempted by learning. Such speculations, however, do not help us to understand the reasons for such differences in modes of response as are illustrated by the reactions of spider monkeys and of chimpanzees in the matching situation. Some phenomena suggest that the kind of relation perceived may be a function of the complexity and number of the nervous schemata which can be activated and integrated at one time. An example from bird behavior may make the meaning of this

statement clearer. The nesting sooty tern holds territorial rights to an area surrounding her nest, and attacks any trespassers. She will rush to the defense of any chick which is attacked, even in a neighbor's territory. Having rescued a chick from the attacks of a neighbor, she herself will immediately attack it, if it runs away. If during her attack the chick runs under her breast, she responds with the hovering reaction, but after a few seconds she begins to peer about and, finding herself away from her nest, stands up, takes a few steps, turns and attacks the chick which she has just hovered. The immediate reaction is to a limited range of stimuli, and adjustment to the conflicting demands of the whole situation is slow. The superior insight into the situation, which makes the bird's behavior seem inadequate and ridiculous to the human observer, lies in the fact that more of the elements of the situation are effective at the same time for us and our reaction to the combination is more rapid.

The perception of relations which seem qualitatively different, such as those of pointing and of likeness in the matching problem, might possibly be reduced to such quantitative terms, depending upon the number of elements in the situation which can be integrated simultaneously. An increasing number of cells and axon connections might make possible the development of a more complex structure, without change in the fundamental mode of organization, just as a larger piece of a regenerating hydroid can develop more nodes of differentiation and so a more complex pattern of tentacles than a smaller one (Child, 1928). Thus far, attempts to analyze processes of generalization into such quantitative terms have been unsuccessful.

A second alternative is that continued research on the finer structure of the nervous system may discover changes in the type of interneural connections which correspond to qualitative changes in behavior. There is little indication of this in current investigations, but techniques for detailed analysis of the finer structural relations in the nervous system are not at present available. Until this problem of continuous or discontinuous steps in the development of the nervous system and of behavior has been solved, a significant correlation of the two will not be possible.

GENETIC DETERMINATION OF SPECIFIC TYPES OF BEHAVIOR

With such a view of nervous organization, what may be the basis of such specific instinctive behavior as the orb-weaving of spiders, or the selective recognition of objects like the egg of the bird or of the young of the species by various birds and mammals? There are indications that the human cerebrum has a predilection for certain types of geometrical organization. In hemianopia most objects are cut off sharply at the edge of the blind field, but simpler geometrical figures like a square or circle cannot be so divided. When only half of such a figure falls within the seeing field, its form is spontaneously completed; it is seen as an entire square or circle (Poppelreuter, 1917; Fuchs, 1920). In one type of migraine, blind spots filled with scintillating lines develop. The form taken by these lines, the so-called fortification figures, is uniform for all subjects and probably represents a preferential pattern of the cortical tissue in spontaneous discharge (Lashley, 1941c).

We have raised the question whether differences in the behavior of animals could be correlated with differences in such tendencies to nervous patterning. Earlier experiments by Hertz (1931) indicated that, whereas for mammals such simple figures as the square or triangle are most readily identified, patterns of radiating lines, like flower forms, are most readily identified by bees. This was interpreted as indicating a difference in the types of perceptual organization in insects and vertebrates. It turned out that the effective stimulus for the bee is the flicker produced by the lines as it flies above them (Wolfe and Wolfe, 1937) and its ready response to flower patterns is not evidence for a different patterning of neural impulses, but the example serves to illustrate the general type of neural mechanism for which we must search in the analysis of instincts. The nesting tern seems to notice no difference when her eggs are dyed red or black but is immediately and greatly disturbed if their smooth contour is altered by sticking on a bit of clay or putty. For her, smoothness of outline is the essential character of the egg. This is the sort of property that can be most easily interpreted in terms of the inherent tendencies to functional organization in the nervous network.

I do not mean to imply by this that the geometry of the web of the spider is exactly represented

in the spider's brain, that the orb tends to be completed as the circle or square are completed in hemianopia. The process of web-spinning is much too complicated for this, but various elementary actions that contribute to the structure of the orb are understandable in such terms. The angle of radii may be determined by the angle at which the legs are held (Peters, 1937); the completeness or incompleteness of the orb may depend upon the readiness with which certain postures are assumed in relation to gravity. Detailed analysis of the steps in web construction will be necessary before explanation of the finished product can be attempted. The simple nest of the rat is piled and pushed about until it satisfies certain sensory requirements of reduced heat loss. The orb of the spider is perhaps a composite of several such sensory requirements combined with some specialized geometrical perceptions such as are illustrated by the rat's more ready recognition of a triangle or circle than of irregular ink blots which differ even more in shape.

A study of complex instincts requires a detailed analysis of the exact stimulus or combination of stimuli which call forth the behavior, combined with descriptions of the behavior elicited. This has been attempted under controlled conditions only for some instinctive behavior of birds (Lorenz, 1939) and for the mating and maternal behavior of the rat, and in no case has the analysis been carried to the limits which are necessary to define the actual properties of the objects which elicit the instinctive responses. It is possible to arrange the webs of different spiders into a series which illustrates their evolution from the tangle of threads of *Theridion* to the perfect orb of *Gasteracantha*, but the webs are the products of behavior and do not tell what has changed in the spiders themselves or how their behavior has altered. The behavior of different species in web-spinning has not been analyzed.

At present there is no factual basis upon which a theory of the heritable mechanisms of specific patterns of behavior can be based. Instinctive acts have generally been described in terms of their products. They must be subjected to analysis in terms of the exact exciting stimuli and of the movements elicited. The behavior of related species must be compared from this point of view. Only then can the evolutionary steps in behavior be profitably compared.

COMPARATIVE STABILITY OF BEHAVIOR TRAITS

Among morphological characters there appear to be very great differences in phylogenetic stability; some basic structural patterns have remained relatively unchanged throughout mammalian and even vertebrate evolution, while others have run the scale of imaginable changes. These differences may be due either to selection pressure or to inherent tendencies to variation. In either case there is some basis for prediction of further changes. In behavioral patterns there are similar differences in stability. I pointed out that the topological arrangement of afferent systems is remarkably constant among vertebrates. The correlated functions of sensory perception are similarly uniform. Studies of visual perception in birds, rodents, and monkeys have not revealed significant differences from man.

Emotional behavior seems likewise to have undergone relatively little change, at least in mammalian evolution. The chemistry of the endocrines is remarkably constant and the reactions of the nervous system to them are equally so. The same types of nervous derangement follow glandular disorders in dogs and in man (Stockard, 1941). The subordinate chicken (Allee, 1942) and the subordinate chimpanzee (Birch and Clark, 1946) become aggressive and dominant under large doses of testosterone.

All investigators who have worked closely with the chimpanzee agree that these apes resemble man far more closely in their emotional and interpersonal reactions than in the behavior designated as intelligent. Descriptions of the social reactions of groups of dogs, associated as in sledge teams, correspond quite closely to the social reactions of the chimpanzees. For example, the dominant male dog and dominant male chimpanzee both grant feeding privilege to the receptive female. It is difficult to objectify and quantify such behavior. Judgments of emotion and temperament in animals are still largely intuitive and prescientific, as indeed they are also in human psychology, but fundamental patterns of emotional reaction and temperamental types seem to have undergone little change in mammalian evolution. The major changes are rather the result of the development of intelligent foresight and the inhibition of action in anticipation of more remote prospects.

Thus two aspects of nervous functioning seem to have remained remarkably stable in mammalian evolution. The highly differentiated structural arrangements, such as the cortical projection of fibers of the visual system, are fundamentally the same in all mammals. Their structure is understandable in terms of tissue polarization in the early spatial differentiation of the embryo. The endocrine-neural relations, influencing the general level of neural activity and the activation of specialized systems, such as those of mating and maternal behavior, seem even more primitive, with mechanisms little changed throughout the vertebrate series.

CONCLUSION

Evolutionary changes between marsupials and man have been almost exclusively an increase in the capacity to discover significant relations among the elements of a situation and to adjust behavior in terms of a maximum number of such relations. It is obvious that we have as yet only the vaguest notion of the neural mechanisms which produce such an organization of behavior. At the level of simple perception a start has been made toward understanding the principles of integration in terms of the properties of a network or lattice of interacting nerve cells. For more complex behavior or more abstract functions we can only guess that the same general principles apply in the interaction of neural schemata established in different lattices.

The student of physical evolution must deal with gene variation and the resultant changes in structure. The student of behavior has to consider an additional step: from gene to brain structure, from brain structure to behavior. The interpretation of nervous organization that I have described somewhat simplifies the first of these steps. Precise neural connections, where they occur, are clearly the result of the spatial characteristics of the developing organism and can be dealt with in the same terms as other structures differentiating in a polarized field. The changes in the integrative network are most probably quantitative; indeed, the difference in behavioral capacity between man and the chimpanzee may be no more than the addition of one cell generation in the segmentation of the neuroblasts which form the cerebral network.

The step from neural structure to an understanding of the details of behavior is more obscure, but I believe that the general principles of organization are within our grasp. Progress toward an understanding of the evolution of behavior depends upon our ability to analyze the properties of the nerve net and to discover the phylogenetic differences in its structure.

Address of the retiring president, American Society of Naturalists, Chicago, Illinois, December 31, 1947.

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NEW BIOLOGICAL BOOKS

The aim of this department is to give the reader brief indications of the character, the content, and the value of new books in the various fields of Biology. In addition there will occasionally appear one longer critical review of a book of special significance. Authors and publishers of biological books should bear in mind that THE QUARTERLY REVIEW OF BIOLOGY *can notice in this department only such books as come to the office of the editor. The absence of a book, therefore, from the following and subsequent lists only means that we have not received it. All material for notice in this department should be addressed to H. B. Glass, Associate Editor of* THE QUARTERLY REVIEW OF BIOLOGY, *Department of Biology, The Johns Hopkins University, Baltimore 18, Maryland, U. S. A.*

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GENERAL BIOLOGY: PHILOSOPHY AND EDUCATION

READINGS IN BIOLOGICAL SCIENCE.

Edited by Irving William Knobloch. Appleton-Century-Crofts, New York and London. $3.00. xiv + 449 pp. 1948.

To quote from the Preface, "Primarily this volume is intended to be read in conjunction with a textbook... In certain situations instructors may desire to use this book independently as background for a lecture or laboratory course. . .It is organized to start with material on life and the cell and then follow a general scheme of watching the green plant make organic food, of animal nutrition, circulation, and so on. Finally, there are several articles of a philosophical nature which, for the most part, seem to integrate the various divisions of biological study. . . .an attempt has been made to focus on articles that are readable and inspiring rather than those of a classic nature... In reproducing the articles herein presented, a certain amount of abridgment was thought to be desirable to enhance readability."

It is to be expected that no two persons would select the same material for a book of this kind. Considerable debate could easily be started concerning the topics as well as the authors that have been included or those that have been excluded. No settlement could ever be reached. Eliminating this controversial subject, it remains only to be said that the idea for the book is good, and its readability is suited to the general taste. There are 15 major topics, each containing from two to nine papers. Not all of these articles are on the same level from a biological or educational point of view, as they range from pure narrative about big game hunting to a more highly involved discussion of heredity. The reader should be warned to check the publication date of each article, as already a few of the statements and claims made by different writers are no longer valid. Whether or not students are stimulated, the reviewer enjoyed the book from cover to cover.

HENRI C. SEIBERT

THE RELIGION OF THE MODERN SCIENTIST (NEO-MATERIALISM).

By S. W. Tromp. A. W. Sijthoff's Uitgeversmaatschappij N. V., Leiden. Fl. 15.50. xxiv + 480 pp. + 42 plates + 3 charts; text ill. 1947.

This is a very unusual book. The author's philosophy is based on two fundamental postulates—that there are no phenomena in nature whose investigation is not amenable to the scientific method: and that, other things being equal, he who has been disciplined by training in scientific method is better qualified for religious leadership than he who has not. These

postulates seem essentially reasonable and probably most interpreters of scientific theory would concede them, but it is not so likely that many will share the author's conclusion, that the only scientific philosophical system is the materialistic one.

In order to connect his conclusion with his basic postulates, the author, who by training and occupation is a geologist, has attempted to write a book in which the entire field of science might be covered—a laudable ambition, but one which can hardly be satisfied between the covers of a single volume, as the almost complete absence of mathematics testifies. In this instance the omission does not necessarily mean that mathematics does not appeal to the materialist, though this may be true; rather it indicates that mathematics is not divided into schools of conflicting thought, as so many other sciences are. There is not and never has been in mathematics anything comparable to the controversies between the preformationists and the epigenesists, the plutonists and the neptunists, or the adherents to the nebular and planetesimal hypotheses. Also there are no fields in mathematics which have been taken over by charlatans for the purpose of pecuniary gain through the exploitation of the gullibility of the ignorant, and from which the sincere scientist who is devoted to the pursuit of truth shies away because he cannot feel at home in such company.

Yet it is these very fields that the author feels are most in need of scientific examination, and a large portion of his book is devoted to such pseudo-sciences as astrology and palmistry, and to the practice of dowsing, which seems to lack even a pseudo-scientific name. The author's discussion of astrology is very pointed. Astrologers teach that differences among individual human destinies are to be attributed to differences in the positions of the planets at the time of an individual's birth, that being the most important event during life and at the time of which the plasticity of the individual is at its maximum. Right here, according to the author, is the reason why so many astrological predictions fail. Birth is not such a significant event as conception, and the embryo is not so sensitive to external influences as the zygote. To be scientific, astrology should take into consideration the position of the planets at the time of conception! Note that the author does not claim the zygote to be subject to planetary influence, but only that no scientifically controlled experimentation has ever been set up to investigate this problem. That such planetary influences may be possible he believes to be indicated by certain observations which he has made on the capillarity and crystallogeny of saline solutions during solar eclipses when the sun and moon are in the same astrological "house." If the form of a salt crystal precipitated from solution is subject to lunar influence, why should it be surprising that a zygote, so much more complex and sensitive than a salt crystal, might be found to be influenced in a similar way?

This reviewer believes such an argument from analogy to be dangerous. He is inclined to doubt that the variations in size and shape of salt crystals, or of the height of a salt solution in a capillary tube, are in any way correlated with the phases of the moon, and he feels that further confirmation of these results is needed. Also he feels very skeptical of the author's statement that the hands of hysterical women luminesce in the dark! The author's explanation of this phenomenon is that the motor impulses by which the brain activates the muscles are essentially electric, and that the discharge of electricity from a charged body takes place at its extremities. In the case of the dowser, this discharge (according to the author) takes place through the dowsing rod, and since the conductivity of wet soil differs from that of dry soil, the dowsing rod undergoes a change of behavior as it approaches subterranean water. If two dowsers approach each other, they will exert a mutual influence on each other, but neither will find water. Again one may be pardoned any inclination to be skeptical.

The author also discusses such matters as telepathy, clairvoyance, levitation, telekinesis, etc. The inadequacy of supporting evidence leads him to reject most of these, but he is strongly convinced of the need for scientific investigation of those occult phenomena which have not been deliberately faked, and which he believes could be accounted for by physical and chemical causes if our knowledge of them were less incomplete.

Tromp has a peculiar literary style which is somewhat reminiscent of Gertrude Stein's, and a weakness for consolidating nouns with their modifying adjectives. Thus he loves to astonish the reader with such words as wroughtiron, cellnucleus, thinkingprocess, mainlaw, bearanimalcule, and eyelense, to mention but a few. Occasionally he goes to the other extreme and writes "in tact" for "intact." He also has a fondness for unusual spellings, such as profet, nickle, phantastic, lizzard, genious, and extasy, and he states that spermatozoids, before uniting with the ova, leave their tales behind them! What an irreparable loss to science!

Idiosyncrasies of this sort might be explained as errors of the translator, but there is nothing in the book to indicate that it was not written in English, although published in Holland. There are other errors for which such an explanation will not suffice. For instance, the author tells us that *vitro* is a special feeding fluid for laboratory use. Can one excuse such taxonomic errors as the assignment of the cicadas to the Orthoptera, the eels to the Cyclostomata, the Chinese to the Aryan race, the hypothetical ancestor of the chordates to the trilobites, or the identification of "*Aedes egypti*" as the micro-organism that causes yellow fever? That the life span of the pearl oyster

exceeds a century, and that eunuchs live as long as normal individuals may be true statements, but without documentation they are not very convincing. And the statement that Tamerlane commanded the Turkish army which invaded Europe in the eleventh century is a serious lapse. Actually the Turkish invasion occurred in the fifteenth century and the chief factor in its failure was probably the crushing defeat of the Turks by Tamerlane and his army of Tatars at the battle of Angora.

The author's purpose in writing this book is to establish neomaterialism as a religion. This appears to be a contradiction in terms. Philosophy may be materialistic, but a materialistic religion would be no religion at all. However, this is a matter of little importance. The real value and significance of the book is that it is an exhortation to the scientist to undertake research in a field which he too often considers beneath his dignity. Some occult phenomena may be dismissed at once as hoaxes, but others are too well authenticated to be ignored, and the only way their nature may be understood is by the rigid application of the scientific method.

SCIENCE FINDING GOD. *Personally Conducted by God; the Pearly Gates or Heaven a la Mode.*

By David A. Murray. Wetzel Publishing Company, Los Angeles. $1.00 (paper). 146 pp. + 1 plate. 1947.

One at first finds it difficult to repress a smile at the naivety of this book's title and subtitle. If, nonetheless, the scientific reader will peruse the first part of the book, he will find that the author is not altogether lacking in perspicacity and courage. He has recognized the crucial problem of a vitalistic philosophy: the need to show that "Spirit has the power to control physical energies." He grapples with the meaning of the existence of Order in the universe and with the teleological viewpoint. Against the fact that he is clearly no biologist and readily falls into the snare of Lamarckianism, one can put down as a balancing fact that his solution of the main problem, stated above, is simpler and no more subject to criticism than, let us say, the conclusions reached by Lawrence J. Henderson or Ralph Lillie. Granting the primary assumptions Murray has made—and is there anyone who does not have to make basic assumptions?—the logical edifice is sound enough. One does not need, of course, to conclude with the author that science does prove the existence of God. It seems safer to question the primary assumptions and to conclude that science can neither prove nor deny the existence of God.

Parts 2 and 3 of the book are wholly religious in character and need not concern us here. As a whole, the book is an interesting product of the lifelong effort of a religious man, untrained in science but not lacking in intelligence, to resolve the doubts raised in the human mind by the advances of scientific knowledge.

BENTLEY GLASS

BIOLOGY: HISTORY AND BIOGRAPHY

LES SCIENCES DE LA VIE AUX XVII^{e} ET XVIII^{e} SIÈCLES: L'IDÉE D'ÉVOLUTION. *L'Évolution de la Pensée Scientifique; Bibliothèque de Synthèse Historique; l'Évolution de l'Humanité.*

By Émile Guyénot. Éditions Albin Michel, Paris. 180 fr. (paper). xxiv + 462 pp. 1941.

It would be hard indeed to find another work dealing with the history of the biological sciences worthy to stand beside this one. In every respect it is marked by excellence: profound scholarship; a broad and comprehensive view of the interrelationships of biological concepts and discoveries; a happy organization, not simply chronological yet not non-chronological; a clear and forceful style; a sense of climax.

The chosen theme is that of the history of an idea, the concept of organic evolution, in the seventeenth and eighteenth centuries. The book is divided into four parts, the first three of which deal with the substrate upon which the idea germinated and grew. These three parts are: The Progress in the Knowledge and Classification of Living Beings; Anatomy, Physiology, and Biology of Organisms; and The Problem of Generation. The fourth part then deals with The Birth of Organic Evolution (or, as French biologists still term it, *transformisme*). Within each of the four parts of the book the treatment is fairly strictly chronological, the author exhibiting no hesitation, wherever he has felt it would be desirable, in going back to a time before 1600 to trace the beginnings of some particular influence.

It is invidious, for a work of such unity and excellence, to single out particular portions for praise. Yet one cannot help mentioning the great service Guyénot has performed in rescuing the work of Adanson from oblivion and reestablishing its basic relation to the revolution in taxonomic concepts during the eighteenth century. In the section on evolution proper, the analyses of the contributions of Linnaeus, Buffon, Maupertuis, and Lamarck are indeed masterly. This is a book that one must sincerely hope will soon be translated into many languages, including our own.

BENTLEY GLASS

DOCTOR FREUD. *An Analysis and a Warning.*

By Emil Ludwig. Hellman, Williams & Company, New York. $3.00. 317 pp. 1947.

Admirers of either Ludwig or Freud are likely to be gravely disappointed by this volume. The biographical analyses of Ludwig have been duly respected for the great works among them, but they have been irregular in quality. The present volume, in the opinion of one who has read most of them with great interest, represents an effort so poor and so ill-chosen as to be unworthy of inclusion with them.

In his preface Ludwig mentions that his writings have been primarily "of an affirmative and positive nature," the present analysis representing a third departure into the realm of destructive criticism. This statement indeed sets the tone of the work. The primarily sexual Freudian interpretations are heckled with sarcasm through thirty-seven unpleasant chapters. Everywhere the approach is excessively literal, every interpretation eliciting its portion of critical venom. Nowhere is any attempt made to interpret Freud in the light of his broader influences, such as the introduction and development of the dynamic approach, the technique of revelation by long continued examination, etc., which have been conceded, even by those who have little patience with Freud's special interpretations, to constitute his greatest contributions.

The book is divided into three parts. The first is devoted to analyses of patients examined by Freud and a general defamation of his method, the second to the analysis of "historical victims" of Freud and his pupils. Ludwig points out that others have equal access to these "patients" and can judge on comparable terms. This shrewd argumentative device might have been effective, had not the author lost himself in the same sort of unremittingly ill-tempered criticism that characterizes the first part of the book. The third part is devoted to Freud as a personality and resembles the sort of analysis that characterizes other Ludwig writings. However, the uniformly destructive touch is evident even here.

In short, this tedious book is unworthy of the author. It offers nothing to the biologist and little if anything to the educated lay reader.

F. N. Low

GEORGE CRILE. *An Autobiography. Volumes 1 and 2. Edited, with sidelights, by Grace Crile. J. B. Lippincott Company, Philadelphia and New York.* $10.00. xiv + 306 pp. + 8 plates; viii + pp. 307–624 + 8 plates. 1947.

George Crile was born on a farm in Ohio in 1864. He graduated from Wooster Medical School in Cleveland, Ohio, in 1887, after attending lectures during two terms (8 months in all). He practised all his life in Cleveland, and died, one of America's best known surgeons, in 1943. His life thus coincides with the sudden and spectacular rise of American scientific medicine, of which he was one of the pioneers.

Crile was a superb technician, showman, and organizer. He was filled with a faustian urge toward scientific truth. In his purely scientific work, which centered around shock in all its implications, his sweeping generalizations have not always found general recognition.

The 600 pages of autobiography give Crile an ample opportunity to report on his practical experiences, his pet theories, his participation in two wars (the Spanish American, and World War I), and his numerous travels in Europe, the Far East, Africa, the Arctic, etc. Crile's opinion of other outstanding surgeons of his time (e.g., Halstead) is generally not very charitable. His unrestrained admiration for George Crile carries him often to attribute to himself work accomplished decades before his birth (e.g., in the case of shock experimentation, CO poisoning). As a source of objective information George Crile's autobiography is therefore of very limited value.

ERWIN H. ACKERKNECHT

THE RESCUE OF SCIENCE AND LEARNING: *The Story of the Emergency Committee in Aid of Displaced Foreign Scholars.*

By Stephen Duggan and Betty Drury. The Macmillan Company, New York. $3.00. xiv + 214 pp. 1948.

This is the story of the way in which two hundred and sixty-five displaced European scholars were brought to the United States during the recent war to continue their studies and investigations in American colleges and universities. These people were forced to leave their homelands, not because there was no further need for their services, but because their intellectual ideals were incompatible with the aims of the totalitarian dictators who had seized political power, and whose plans could not be carried out until scholarship had been suppressed and the scholars themselves expelled.

The story is a lesson for all those who complacently discount the increased centralization of government in this country with the unthinking statement that "it cannot happen here."

ORGANIZING SCIENTIFIC RESEARCH FOR WAR. *The Administrative History of the Office of Scientific Research and Development. Science in World War II. Office of Scientific Research and Development.*

By Irvin Stewart, with foreword by Vannevar Bush. An Atlantic Monthly Press Book; Little, Brown and Company, Boston. $5.00. xiv + 358 pp. 1948.

Whereas *Advances in Military Medicine* cannot be

recommended to biologists as essential reading, *Organizing Scientific Research for War* will serve as an excellent reference for all who are interested in the administrative and other problems raised by government-supported agencies, such as the OSRD, and which will be raised by the passage of any act eventually establishing a National Science Foundation or its equivalent.

That the OSRD managed as well as it did is amazing. It got off to a rather bad start by treading on the toes of the one group, the military, whose cooperation was necessary. The OSRD was brought into existencr through the efforts of a few scientists, led by Vannevae Bush, who were acutely aware that the United States was unprepared to fight a modern war. Regardless of the possibility that many other factors might be responsible for that condition, most observers drew the general conclusion that the situation was the result of the limited imagination exhibited by the Armed Services in developing new and more effective instruments of warfare. Furthermore, the same scientists, aware of the fact that modern science had developed to a point where the military heads were not sufficiently acquainted with its possibilities, drew up plans of the OSRD such that the organization could, if necessary, make "its own assessment of what the Armed Services need and which could then, preferably with the assistance of the Services but over their opposition, if necessary, go about the business of getting the necessary weapons developed." Finally, the success of the entire undertaking depended on joining in marriage two groups that are inherently incompatible. That two such divergent groups as college professors, on the one hand and the military, on the other, were brought together in effective collaboration is a tribute to its director and to the staff he gathered around him, and also to the openmindedness of some military officers.

Irvin Stewart, as Deputy Director of the OSRD and Executive Secretary of its Administrative Office, had the job of providing the supporting mechanism whereby scientists engaged in both NDRC and CMR projects could function as efficiently as possible within the limits of government regulation. The reviewer would like, belatedly, to withdraw all of his own complaints about some bits of red tape that the Administration Office could not eliminate. The array of variegated headaches that constantly afflicted that office were undoubtedly tremendous.

There are many sections in this book of extreme interest to the biologist: that on the proposed Scientific Corps (pp. 262–264), the entire section on Scientific Manpower, and the chapter Retrospect and Prospect, to mention only a few, are recommended reading. (This is not to imply, however, that the reviewer agrees with all the proposals presented by Dr. Stewart.)

Many others might profit by reading this account of some of the OSRD activities and purposes, those, for instance, who point with great enthusiasm to certain major accomplishments of the OSRD, and who demand in the name of our country's security and progress that science be not only supported in a manner to which it has not been previously accustomed but that the mechanism of that support be patterned after the OSRD! Reading, we hope, they will be reminded that the OSRD was created to do an important but *temporary* job. It was successful in its mission because of a number of factors: it succeeded in attracting the best available men to work under highly organized conditions largely because of the pressure of war and the resulting patriotic fervor. This made available men whose services could not have been obtained on a comparable scale during peace. Once the pressure of war was removed, "not all the king's horses nor all the king's men" could hold the group together.

Finally, *Organizing Scientific Research for War* should be a suggestive guide for the Army, Navy, and Air officers, not only at the top level, but at all levels concerned with research and development. At the present writing, an act for the creation of a National Science Foundation has not yet been approved; and a very great portion of the support science is receiving today comes from the military forces. It will be interesting to see what, if any, permanent change has occurred in the attitude of the Services as a result of their experience with the OSRD. There are some indications that the honeymoon is ending.

DAVID B. TYLER

ECOLOGY AND NATURAL HISTORY

DESERTS ON THE MARCH. *Second Edition.* *By Paul B. Sears. University of Oklahoma Press, Norman.* $2.75. xii + 180 pp. 1947.

In 1935 *Deserts on the March* won a $2500 prize (see QRB 11: 226. 1936). Few books have done more to awaken Americans to their blind and needless waste of the one ultimate national resource, the soil. It is gratifying that after the passage of twelve years the author is able, for the second edition, to add a final chapter telling of the progress made in checking this insensate destruction. Much has indeed been done. Many groups interested in different aspects of conservation have come to realize the common interrelationships of their problems and have begun to make common cause. The government has taken an outstanding part in the rehabilitation of eroded and denuded areas and in the reeducation of the people. The Tennessee Valley experiment points the way to cooperative efforts in conservation. And yet, the author points out, there is still a vast deal of misunderstanding on the subject between biologists and civil engineers and our representatives in local and federal government. There is still a major job of education in this regard before us, and time is running

out. Many a biologist still needs a quickened sense of responsibility for this task.

Deserts on the March bids fair to become a classic in the field of ecology. The new edition, beautifully printed and illustrated with drawings as chapter headpieces, is most welcome.

BENTLEY GLASS

DEATH VALLEY HANDBOOK.

By George Palmer Putnam. Duell, Sloan and Pearce, New York. $2.00. viii + 84 pp. 1947.

The intention of the author in this brief volume is to provide information of interest to tourists about Death Valley. Noteworthy features of the climate are considered first, and a table is presented listing weather statistics over a ten-year period. Less interesting is the treatment given the plant and animal inhabitants of the valley. Indeed, the bulk of the book (53 out of 84 pages) is devoted to a drab check list of the plants. Other lists record the birds, mammals, and common lizards encountered in the monument. Rocks of interest are mentioned in a brief section. The book concludes with a chronology of the highlights in Death Valley's history.

FRANCIS HAXO

SUBMARINE GEOLOGY. *Harper's Geoscience Series. By Francis P. Shepard. Harper & Brothers, New York.* $6.00. xviii + 348 pp. + 1 map; text ill. 1948.

This is the first integrated textbook on the geology of marine coasts and submarine formations. While primarily concerned with physical geology, the reworking of Johnson's shoreline classification and the up-to-the-minute summary of the coral reef problem are of special interest to biologists. The work presents much material of use to marine ecologists, in particular. The author supports the view that there has been a world-wide submergence, indicated especially by submarine canyons and coral formations, in the magnitude of 1,000 fathoms, occurring possibly in the Pleistocene. Submarine geology, however, is an infant science, and the surface (if one may so call it) of the subject is barely scratched in this volume.

If a biologist may venture a criticism of such a work, this admittedly preliminary summary is too heavily overweighted, in its sections on shore formations, in favor of rocky coasts. There is no discussion of the formation of offshore bars and tidal deltas and the forces concerned in this, factors of particular concern to marine ecologists on the South Atlantic and Gulf coasts; and the historical geology of littoral seas has been omitted entirely. Some mention of these matters, especially in details where Johnson's classic *Shore Processes and Shoreline Development* is now out of date, would round out the volume for less specialized readers. The book is well illustrated with charts and photographs, and is provided with chapter bibliographies and an index.

JOEL W. HEDGPETH

LES RICHESSES DE LA MER. *Technologie Biologique et Océanographique. Encyclopédie Biologique, XXIX. By Noël Boudarel. Paul Lechevalier, Paris.* 1,500 fr. (paper). 549 pp.; ill. 1948.

From the history of oceanography to the canning of sardines, this book gives brief, sometimes passing, notice to the marine products of commerce in French waters. It is both a textbook of practical oceanography and a manual of the commercially important invertebrates, fishes, and mammals occuring in the marine waters of France. Figures are presented of all the species discussed, and there is also a section on the plants of the seaside. The chapter on preservation and allied industries is one of the shortest in the book, in strange contrast to the elaborately illustrated chapter on nets and fishing gear. The types of fishing boats are skimpily treated, as well. Nevertheless, the book contains a vast amount of information, and the illustrations, all line drawings, are simple and well done. This book will give a good idea of what they catch from the sea in France and how they catch it, but anyone desiring information on processing will have to look elsewhere. There is an excellent, comprehensive index and a brief bibliography.

JOEL W. HEDGPETH

BETWEEN PACIFIC TIDES. *An Account of the Habits and Habitats of Some Five Hundred of the Common, Conspicuous Seashore Invertebrates of the Pacific Coast Between Sitka, Alaska, and Northern Mexico. Revised Edition.*

By Edward F. Ricketts and Jack Calvin; foreword by John Steinbeck; line drawings by Ritchie Lovejoy. Stanford University Press, Stanford; Geoffrey Cumberlege, Oxford University Press, London. $6.00. xxviii + 365 pp. + 93 plates; text ill. 1948.

Strictly speaking, this is not a revised edition, and it is misleading of the publisher to call it such. In fact, the authors preferred to call it an "amended edition." The book has been increased from 320 to 365 pages, principally by the addition of a 33-page section on the marine plankton of the Pacific Coast and the insertion of new titles in the bibliography. A handsome color plate of chitons has been added as a frontispiece. There is no change in pagination up to page 252, and the original errors have not been corrected on these

pages, although some of them have been corrected in the appendix. It is particularly unfortunate, in view of the senior author's untimely death, that a thorough revision of this unique and invaluable work was not undertaken instead of this interim printing, since it must now stand as his final version. Nevertheless, the book still remains unique among seashore books, both for its interesting style and mass of ecological information, and for its valuable systematic appendix.

The essay on plankton is a welcome addition, not only because the importance of the plankton to littoral life is usually ignored, but as a contribution on its own merits, giving as it does the viewpoint of a bystander trying to evaluate recent plankton research on the Pacific Coast. Some previously unsuspected relationships are demonstrated by a series of graphs and diagrams, although the evidence is admittedly fragmentary.

The criticism has been made of this work, with some justification, that as an ecological treatise it does not devote enough attention to plants, although the Pacific littoral is extraordinarily rich in marine algae. However, it was not the original purpose of this book to serve as a treatise on all phases of marine ecology, but primarily, as stated in the subtitle, to be "an account of the habits and habitats of. . . . .the common, conspicuous seashore invertebrates." It was written, as John Steinbeck states in his brief foreword to this edition, more to stir curiosity than to answer questions. Undoubtedly, had the author lived to complete what was essentially a continuous task, the book would have grown in scope without losing its essential quality. As it is, it must be considered a classic of the surprisingly large literature of seashore biology.

JOEL W. HEDGPETH

EVOLUTION

LIFE, ITS NATURE AND ORIGIN.

By Jerome Alexander. Reinhold Publishing Corporation, New York. $5.00. x + 291 pp.; ill. 1948.

This is not a book for the lay reader. It is too highly technical to be understood by anyone who has not been thoroughly trained in organic chemistry. Perhaps some day we may understand the secret of life and be able to synthetize protoplasm in the laboratory from inert ingredients, but that day is not yet. The author tells us nothing about the ultimate origin of life, but a great deal about the way in which non-living matter might become alive.

A generation ago or so the belief in a great gulf between animals and inanimate nature was generally accepted. Today we are not quite so sure. Are the filterable viruses alive or not? Or are they sometimes alive and sometimes inert? The author seems to be inclined toward the latter view.

The author's argument runs something like this: Inert matter can acquire life only through contact with living matter. Living organisms ingest non-living matter (which may or may not be organic) and later reproduce by separating small parts of themselves which are living and which grow to resemble their parents. The material molecules of which these offspring are composed may at one time have been the identical inert molecules ingested by a parent organism. Thus the conversion of inert into viable matter has come about through contact with living matter.

Alexander would modify the usual chemical definition of catalysis to make it apply to organisms by providing that the presence of a living catalyst may produce a reaction which would not have occurred at all without it. Since life cannot be spontaneously generated, as far as we know, but can arise only in the presence of already existing life, it follows that any increase in the quantity of living matter can be interpreted as an example of catalysis. And since the catalyzing life is of the same kind as the catalyzed life the process is one of autocatalysis. But autocatalytic reactions may take place even among the non-living substances of organic chemistry. Therefore the greatest of nature's cleavage planes is not that between the animate and inanimate worlds, but that between the realm in which autocatalytic reactions can occur and that in which they do not.

The author would probably disclaim being a vitalist, but his statement that autocatalytic reactions cannot be explained by chemical laws seems to indicate that he has more in common with the vitalists than with the antithetical school of the materialists.

The work has two fairly serious defects. Although its documentation is fairly extensive, there are some citations in the text for which no bibliographic references are given, and a few in which the references have been so greatly abbreviated as to preclude the location of the original source. Also, the author is addicted to the use of the ambiguous expression "and/or". This may be appropriate in a legal document in which the author does not wish to commit himself to an inflexible interpretation, but in a serious scientific work it is entirely out of place. There is an index of subjects, and another of authors cited, which together comprise twelve pages.

VERTEBRATES FROM THE UPPER MOENKOPI FORMATION OF NORTHERN ARIZONA. *University of California Publications, Bulletin of the Department of Geological Sciences, Volume 27, Number 7.*

By S. P. Welles. University of California Press, Berkeley and Los Angeles. $1.00 (paper). Pp. 241–294; ill. 1947.

This paper does much to fill in a lamentable blank in

the North American fossil record. Late Triassic vertebrates are known in abundance from the Newark Series of the East and the Chinle and other western formations (although this abundance consists almost exclusively of phytosaurs and metoposaurid skulls). But there has been in the past practically no trace of the continental life of America in earlier Triassic times, the only exception being an amphibian skull found by Brown a few years ago in pre-Chinle strata. The persistent and thorough series of explorations of the Triassic beds of the Southwest by Camp and his co-workers of the University of California have at length brought to light faunas from the Moenkopi Formation, dating from earlier Triassic levels. The present work, whose author was active in these expeditions, gives an account of the specimens from a quarry near Holbrook, Arizona. Descriptions of further materials from other sites are promised for the future.

At the Holbrook quarry there were found palaeoniscoid scales, and numerous spines of the hybodid shark *Leiacanthus*. Reptilian remains are fragmentary, consisting of waterworn and broken vertebrae, limb bones, ilia, and isolated skull elements. Judging from the teeth, two forms at least are present, a pseudosuchian named *Arizonasaurus*, and *Anisodontosaurus*, a new genus of uncertain position, based on a dentary with enlarged and swollen "molars."

Three amphibians are determined. The new genus *Taphrognathus* is based on a good dentary which shows for the first time the presence in North America of one of the peculiar short-headed plagiosaurid (or brachyopoid) labyrinthodonts. A skull fragment showing a closed otic notch gives a basis for the identification of a species referred to the Old World capitosaur genus *Cyclotosaurus;* and various other skeletal elements are assigned to this form. A second, smaller, cyclotosaur-like amphibian, represented by a variety of materials, is named *Rhadalognathus*.

That the fauna is an older one than that of the Chinle or Newark seems certain. The Moenkopi is usually considered as having been formed quite early in the Triassic, but capitosaurs with a closed otic notch are unknown before the middle part of the period. Possibly the Moenkopi, despite its restricted thickness, includes Middle as well as Lower Triassic horizons.

A. S. ROMER

THE MAMMAL-LIKE REPTILE LYCAENOPS. *Bulletin of the American Museum of Natural History, Volume 89: Article 6.*

By Edwin H. Colbert. American Museum of Natural History, New York. $1.00 (paper). Pp. 353–404 + 8 plates; text ill. 1948.

A skeleton of the gorgonopsian *Lycaenops* was discovered by Broom in 1920 and formed the basis of a rather extensive account by him in the *Philosophical Transactions* a few years later. The specimen was subsequently acquired by the American Museum of Natural History. Recently it was decided to prepare the specimen for exhibition as a mount. Preparation brought to light many new morphological characters, which are described in this valuable paper.

The study of the mammal-like therapsids of South Africa has been, quite naturally, concentrated on questions of skull morphology and the evolutionary position of these forms in the ascent from reptiles to mammals. Relatively little attention has been paid to postcranial anatomy, or to a consideration of therapsids as once-living organisms. Colbert's work is refreshingly different in its viewpoint. He does describe a number of morphological details revealed by recent preparation. However, his emphasis is on the animal as a whole: its mode of locomotion, its probable habits, probable appearance, its place in nature. The mount is, as far as I am aware, the first of any carnivorous therapsid to be exhibited except in Russia. It is well shown in Colbert's figures, and he has in addition a good life restoration (by John Germann). As a result, we get a portrait of *Lycaenops* as a living organism, going about its business of being a gorgonopsian, not as a mere inert figure perched in a mammalian family tree.

A. S. ROMER

THE FOSSIL BISON OF ALASKA AND PRELIMINARY REVISION OF THE GENUS. *Bulletin of the American Museum of Natural History, Volume 89, Article 3.*

By Morris F. Skinner and Ove C. Kaisen. The American Museum of Natural History, New York. $2.25 (paper). Pp. 123–256 + 19 plates; text ill. 1947.

The bison, evolved in the Old World at about the beginning of the Pleistocene and reaching the New World during an early interglacial stage, rapidly became one of the two most abundant members of the ungulate fauna of the Holarctic plains. In both hemispheres the bison was, it appears, a major object of the chase for ancient hunters, and fossil bison thus have anthropological as well as paleontological importance.

Comparable to the prolific development of the bison itself during the Pleistocene has been the prolific spawning of specific names for fossil bison by recent scientists. No less than 65 species have been proposed. Most paleontologists have looked at this list with a jaundiced eye. Bison anatomy in general is monotonously uniform, and teeth are of little or no value in systematics. (In fact, as Boule long ago pointed out, it is difficult if not impossible even to distinguish between cow teeth and those of bison.) Most species have been based solely on horn cores—on differences in size, shape, and position of these structures. How

valid these features may be in specific definition is an open question. Horn development is obviously liable to variation with sex, age, and the individual. Under the diverse climatic conditions met with in an American distribution which extended from the Yukon to Florida and Mexico, it is further reasonable to expect considerable phenotypic variation due to environmental influences within a population which might have been genotypically rather uniform.

The work of Skinner and Kaisen is based primarily on the large number of skulls in the Frick Collection, derived from gold mining operations in the Fairbanks region of Alaska. In addition, the authors have studied most of the American material in other museum collections. As the result of their studies they have reduced the number of presumably valid species to 27—less than half the original number—and have grouped these into six subgenera. This is a worthy advance toward simplification of a confused picture. The subgenera and species remaining, however, are still not too clearly separable in many instances. The writers, for example, cite (p. 165) the case of a single skull of a woodland bison which has been referred by successive workers to three different species and three subgenera! Perhaps further knowledge may permit still further reduction in the number of species.

The stratigraphic and geographic distribution of the remains led the authors to the conclusion that the invasion of North America by the bison took place in two waves. A first wave had spread to the United States by Middle Pleistocene times and was there isolated by recurrent glaciation. Although surviving to a late date in *B. antiquus*, the members of this first wave eventually became extinct, and the existing North American species is a descendant of *B. occidentalis*, a later immigrant. Up to the end of the early Pleistocene, bison species appear to have undergone a process of progressive horn core enlargement. Geologically later species, however, began a process of retrogressive evolution, and the horns of the existing bison are of modest proportions.

A. S. Romer

Bibliography and Index of Geology Exclusive of North America. *Geological Society of America, Volume 12—1947.*

By Marie Siegrist and Eleanor Tatge. Geological Society of America, New York. $3.50. x + 359 pp. 1948.

This volume includes not only the bibliography and index for publications of the year 1947 but also a number of items of earlier date that were delayed because of war conditions. One can only repeat that this is the finest example of scientific indexing in any of the fields directly or remotely pertaining to the biological sciences. To anyone interested in keeping up with the advances of paleontology outside of North America, this reference work is indispensable.

Bentley Glass

GENETICS AND CYTOLOGY

The Genetics of Garden Plants. *Third Edition. By M. B. Crane and W. J. C. Lawrence, with a foreword by Sir Daniel Hall. Macmillan and Company, London.* $3.50. xviii + 299 pp.; ill. 1947.

The second edition of this book (cf. QRB 14: 467. 1939) preceded the present edition by nine years of rapid advances in applied genetics. The authors undertake to provide an introduction to the essential principles of genetics and cytology as well as to give an account of the recent advances of these fields in relation to horticulture. Particularly valuable, because of the participation of the authors or their close associates in the original research, are the accounts of the chemical and genetical basis of flower color, of incompatibility and sterility, and of the work done on the fruits and berries. The discussion of xenia has been expanded to an entire chapter. The coverage of work done outside of Great Britain is not so complete. The development of new autopolyploid and allopolyploid varieties by the use of colchicine, the breeding of tomatoes resistant to *Fusarium* wilt, of cucurbits resistant to aphids, of cantaloupes resistant to downy mildew and aphids—to select at random a few examples—are slighted or unmentioned. In view of its great significance at the present time, one would also have expected a consideration of the work of Lysenko's group on graft hybrids; but, although graft chimaeras studied by earlier workers are described, there is not a word about the Russian tomato, potato, tobacco, and *Datura* grafts. Suffice it to say that the book is very good as far as it goes, but by no means lives up to its title, in the light of present knowledge.

Bentley Glass

Heredity. *McGraw-Hill Publications in the Zoological Sciences. Fourth Edition.*

By A. Franklin Shull. McGraw-Hill Book Company, New York and London. $4.00. x + 311 pp.; ill. 1948.

Without undergoing any major change, this well-known textbook has been brought up to date by the inclusion of such topics as the biochemical mutants studied in *Neurospora*, the Rh blood types, chemical mutagenic agents, and the like. Gene action has been discussed in a separate chapter. Major emphasis has been placed on human heredity and applied genetics, and the book has been somewhat shortened by condensing or omitting the discussion of principles

not clearly applicable to these fields. The chapters on human population problems and immigration have been brought up to date.

BENTLEY GLASS

ANIMAL BREEDING. *Fourth Edition.*
By Lawrence M. Winters. John Wiley & Sons, New York; Chapman & Hall, London. $4.50. viii + 404 pp.; ill. 1948.

This well known textbook needs little introduction to teachers and students of animal husbandry. It has been expanded to include a great deal of new material that appeared in the literature from 1940 to 1946, and although no attempt was made to review all the literature dealing with animal breeding, it will give to the student a satisfactory background of the pertinent studies in this field.

Many of the chapters have been rearranged, and almost all have been revised to include recent developments. A new chapter, Building Superior Germ Plasm, has been added as the closing chapter and presents to the student detailed information on how to use modern methods of breeding. For this chapter Winters has drawn on much of his own research.

This well organized new edition should provide the student with a satisfactory background of the fundamental principles of animal breeding as well as the various procedures that are used.

DAVID B. TYLER

GENERAL PHYSIOLOGY

A TEXTBOOK OF GENERAL PHYSIOLOGY. *McGraw-Hill Publications in the Zoological Sciences. Fourth Edition.*
By Philip H. Mitchell. McGraw-Hill Book Company, New York, Toronto, and London. $7.50. x + 927 pp.; ill. 1948.

With the aim of giving the student an awareness of the broader aspects and interrelationships of physiological function, Mitchell has extensively revised this textbook. The first edition was originally designed for use by students who have studied introductory biology, chemistry, and physics, but who have not yet had organic or physical chemistry. As a result of three revisions since 1923 and the addition of much new material, an adequate background in chemistry is now demanded of the student if he is to fully appreciate all of this text.

The more complete revisions in this edition cover excitation, contraction, the structure of living matter, the permeability of cells, and nutritive requirements. The chapter on biological oxidation has been entirely rewritten, and a new chapter on intermediary metabolism has been added.

DAVID B. TYLER

GENERAL AND SYSTEMATIC BOTANY

DANISH SPECIES OF ALTERNARIA AND STEMPHYLIUM. *Taxonomy, Parasitism, Economical Significance. Communication from the Phytopathological Laboratory of J. E. Ohlsens Enke, Copenhagen.*
By Paul Neergaard. Einar Munksgaard, Copenhagen; Humphrey Milford, Oxford University Press, London. Dan. cr. 60.00 (paper). 560 pp.; ill. 1945.

This book is one of the most comprehensive and authoritative accounts of special groups of fungi that has ever appeared. The vast amount of data presented by the author as the result primarily of his own researches is beautifully organized and abundantly illustrated. After a Preface in which fitting acknowledgment is given, among others, to the seed firm of J. E. Ohlsens Enke which made possible the publication of the present volume, there follow a Table of Contents and an Introduction. In the latter, considerable attention is given to an historical account of the genera treated. Under the title General Part are taken up such topics as (1) Materials and Methods, in which are described methods of isolation, morphological examination, physiological tests, investigations on pathogenicity, experimental conditions, and estimation of degree of infection; (2) Nomenclature, in which are outlined general nomenclatorial considerations and their application to the species under consideration; (3) Terminology, in which the names given the special morphological features of these fungi are briefly discussed; (4) Taxonomy, wherein are discussed specific morphological and physiologic-pathogenic criteria utilized in distinguishing species. This part of the book closes with a key to the sections of the genera and to the species.

The following 293 pages, termed Special Part by the author, are devoted to an exhaustive account of individual species of the two genera. As illustrative of the treatment accorded a single species, that of *Alternaria tenuis* may be considered. After a list of synonyms, further treatment of the species occupies 41 pages containing 13 figures and 13 tables and graphs, under the following headings: (1) Nomenclature and History; (2) Distribution and Economic Significance; (3) Morphology; (4) Physiology; (5) Pathogenicity.

The last 173 pages of text are entitled General Remarks on Cycle and Control of the Fungi. Here are considered the relationships of certain species of these Imperfecti to the Ascomycetes, the cycle of plant diseases caused by species of *Alternaria* and *Stemphylium*, control measures and summaries in English, Danish, and Esperanto. The book closes with a 33-page Bibliography, an Index of Fungi, and a Host Index.

Obviously, it is difficult for one not a specialist in these two genera of fungi to evaluate critically the vast amount of data assembled by the author. One can sense, however, from the careful manner of pre-

sentation, the readability of the text, and the splendid array of illustrative material, that Neergaard has given us not only a new conception of comprehensiveness in the study of small groups of fungi but a contribution to mycology of lasting significance.

F. K. SPARROW

HOW TO KNOW THE TREES. *An illustrated key to the most common species of trees found east of the Rocky mountains, with suggestions and aids for their study. Pictured-Key Nature Series. Revised Edition.*

By H. E. Jaques. Wm. C. Brown Company, Dubuque, Iowa. $2.50 (cloth); $1.50 (spiral). iv + 166 pp.; text ill. 1946.

Another in the useful "Pictured-Key Nature Series," the present volume is a revision of one published in 1941, and is done by photolithography. It is available in cloth or in spiral binding, and is designed especially for schools and nature groups that need a ready means of identifying the more common species of trees found east of the Rocky Mountains. The keys themselves make up most of the book, but there are introductory discussions on the nature, cultivation, structure, and physiology of trees. The names used are taken from the check list published by the United States Forest Service. For the benefit of teachers there is a list of study projects that can be used in schools. The illustrations in the key are line drawings showing leaf, flower, fruit, and winter bud characters. In most cases range maps are included. At the end of the book are a list of trees, arranged in systematic order, and an illustrated index-glossary.

H. M. RAUP

STUDIES OF CENTRAL AMERICAN PLANTS—VII. *Botanical Series, Field Museum of Natural History, Volume 23, Number 5, Publication 609.*

By Paul C. Standley and Julian A. Steyermark. Field Museum of Natural History, Chicago. 75 cents (paper). Pp. 193–265; ill. 1947.

This paper consists almost wholly of the descriptions of new species of Guatemalan plants. Although most of the novelties are described by Standley and Steyermark, four new species in the Acanthaceae, illustrated by line drawings, were contributed by Emery C. Leonard, and a new species of *Passiflora* by Ellsworth P. Killip. In all, there are descriptions of eighty-four novelties and several new nomenclatorial combinations. One new genus of Rubiaceae is proposed by Standley.

H. M. RAUP

CHECKLIST OF PLANTS OF GRAND CANYON NATIONAL PARK. *Bulletin Number 10. Third Edition.*

By W. B. MacDougall. Grand Canyon Natural History Association, Grand Canyon National Park, Grand Canyon, Arizona. 50 cents (paper). iv + 126 pp.; ill. 1947.

A check list arranged in systematic order and containing brief notes on the general distribution of species in the Grand Canyon National Park. Common names are included where they are useful, but apparently no attempt has been made to force them into being. Synonyms are added only when they are necessary for the clarification of nomenclature. The present volume is the third edition of the check list. The author states that in this edition "the policy has been adopted of including only those species of plants that are represented by specimens in the Grand Canyon National Park herbarium, or for which there exists authentic evidence of collections having been made within the Park boundaries." At the end of the text is a general index to families, genera, and species. The book is paper-bound, and is printed by offset from typewritten sheets.

H. M. RAUP

MANUEL PRATIQUE DU BOTANISTE HERBORISANT.

By G. Bimont, with preface by M. A. Maublanc. Éditions N. Boubée & Cie., Paris. 90 fr. (paper). 88 pp.; ill. 1945.

This is a small, paper-backed booklet prepared as a practical manual for botanical collectors. It contains, in addition to suggestions regarding the collection and preservation of botanical specimens, notes on nomenclature, a glossary of botanical terms, and, since it is written primarily for French students, a bibliography of French floristic works arranged by departments or regions. A brief resumé of chapter headings will give an idea of the contents of the book: Materials and Equipment for the Collector; The Location and Selection of Specimens; A general statement on the methods of determination of specimens; a chapter on the microscope and its applications with instructions for making simple dissections; a chapter on the preparation and drying of specimens with notes on methods of protecting a collection from insect pests; a section on the preparation of a herbarium; and a discussion of nomenclature, with extracts from the international rules of botanical nomenclature. Throughout the book the notes on collection, determination, and preservation of specimens are subdivided according to the major groups in the plant kingdom—phanerogams, vascular cryptogams, bryophytes, lichens, fungi, and algae.

The book appears to contain little or nothing that cannot be found in similar publications gotten out in America during recent years. In fact, it is somewhat

less useful for the serious collector of plants than papers that have been produced here. For instance, it has nothing on the drying of most flowering plants and ferns over artificial heat, a method which many botanists who collect on a large scale find indispensable. Heat is recommended only for very fleshy plants.

H. M. RAUP

PLANT PHYSIOLOGY

SOILLESS GROWTH OF PLANTS. *Second Edition.*
By Carleton Ellis and M. W. Swaney. Reinhold Publishing Corporation, New York. $4.75. x + 277 pp. + 3 plates; text ill. 1947.

Practical experience gained in hydroponics since the appearance of the first edition in 1938 has led to the present revised edition, which is enlarged and widened in scope. Horticulturists, students of hydroponics, and the interested layman will find this book of value as an authoritative and informative guide to the methods, applications, and problems involved in the soilless culture of plants.

FRANCIS HAXO

GENERAL AND SYSTEMATIC ZOOLOGY

ANIMAL BIOLOGY. *Fourth Edition.*
By Michael F. Guyer. Harper & Brothers, New York. $4.50. xviii + 780 pp. + 1 plate; text ill. 1948.

The present revision of this college textbook has not introduced any fundamental alterations, although the book has been completely reset. The sections on protoplasm and the cell, on the endocrines, and on the autonomic nervous system show most change. A few new topics have been introduced, such as the Rh blood types in man, but other advancing fronts in biology are not so well reported. For example, the discussion of enzymes is still restricted almost entirely to digestive enzymes, and the relationship of vitamins to enzymes is not pointed out. Again, the chemical induction of mutations is restricted to a mention of the chromosome changes brought about by colchicine. On the whole, however, this is one of the best-balanced and most accurate textbooks available. Those with whom the earlier editions found favor will continue to like the new one. See QRB 17: 79, 1942, for a review of the third edition and references to reviews of the earlier ones.

BENTLEY GLASS

AN INSECT BOOK FOR THE POCKET.
By Edmund Sandars. Geoffrey Cumberlege, Oxford University Press, London. $3.75. 349 pp.; ill. 1946.

This little book fits the pocket and should make an ideal companion for those who love the out-of-doors and are interested in the millions of small creatures in field, forest, or stream. Though mainly applicable to England, yet the reader will find most of the illustrations and the delightful discussions applicable to the many insects he will observe about him. There is a brief chapter on insect structure and classification. No keys are given, although a few tables appear here and there to help place the specimens, e.g., in the Diptera, Coleoptera, Hemiptera, and Hymenoptera. However, these are hardly necessary—for the colored pictures and the black and white sketches will enable anyone to identify the order, family or, in many cases, even the species. In our own country Lutz's *Field Book of Insects* has given untold pleasure to thousands. This companion volume, with its delightful notes and discussions of insect activities, should be a welcome addition to it. The binding, presswork, and illustrations are all of good quality.

ROBERT MATHESON

A HANDBOOK FOR THE IDENTIFICATION OF INSECTS OF MEDICAL IMPORTANCE. *Second Edition.*
By John Smart; With Chapters on Fleas by Karl Jordan and on Arachnids by R. J. Whittick. British Museum (Natural History), London. 20s. xii + 295 pp. + 13 plates; text ill. 1948.

The title of this book indicates its contents. It is a revision of the first edition (1943), considerably enlarged and improved. The insects treated are those of the Old World only. The first chapter deals all too briefly with the structure of insects, their classification, and a brief note on their zoogeography. However, the main emphasis here, as throughout the book, is on correct identification, since mistakes may entail and have entailed loss of time, effort, and money. The main group treated is the Diptera (182 pages of the 280 of the text), in which order the family of the Culicidae (mosquitoes) alone requires 105 pages. Indeed, it might almost be called a short monograph of the Anophelini, since these occupy 78 pages of the 105 devoted to mosquitoes. The fleas, to which the ordinal name of the Suctoria is given, require 35 pages; all other insects, ticks, mites, and spiders are restricted to only 63 pages of the text.

The tsetse flies (*Glossina* spp.) are treated almost entirely from a sysematic viewpoint, with keys and illustrations. Only generalizations on their distribution and habits are given, whereas one would have hoped for a detailed account of those species that are important vectors of human disease, based on the vast amount of recent work done on them. The myiasis-producing flies are briefly treated and, as the writer states, with as much detail as is warranted from

the medical viewpoint. The key to the larvae of these flies is elaborate and difficult to follow, though numerous illustrations serve as excellent aids.

The Culicidae (mosquitoes) are treated in great detail, especially the tribe Anophelini. Keys to adults (females) and larvae (4th stage) are given for the Old World, i.e., the Palearctic, the Ethiopian, Oriental, and Australian regions. The identification of males is indicated only where female characters are not distinctive. A grouping of species according to breeding places is noted in the keys by designated letters and numbers. This is followed by a list of important synonyms, a list of common misidentifications, and a list of the important malaria vectors. There is also a table showing the distribution of anophelines.

The fleas are treated by Jordan. The external morphology of fleas is fully illustrated except for the mouthparts. Keys to super-families, sub-families and, in some cases, to families, genera, and species are given. However, unless one is an expert, the difficulty of interpreting these keys is very great. It would seem that the identification of fleas to species is indeed so difficult that, except for the most common species, they should be submitted to specialists. Jordan in fact emphasizes this need.

The minor groups are treated briefly. More space should have been devoted to ticks which, next to the mosquitoes, are vectors of more diseases of man and animals than any other group of arthropods. There is no bibliography, but references are scattered throughout the book under the various groups discussed.

This book should prove of great value to workers in the Old World. Although the diseases transmitted by the various groups of insects are usually mentioned, very briefly, in connection with the taxonomic treatment, there is no description of how they play their part. A brief outline of how mosquitoes transmit malaria, dengue, filariasis, etc.; how ticks transmit diseases caused by rickettsias and other agents; how lice act as vectors of typhus, relapsing fever, etc.; how fleas serve as vectors of plague; and others, including the transovarial transmission in many cases, would more clearly show the part insects play in the epidemiology of diseases as well as their transmission. However, the authors have specifically excluded such information, in spite of the fact that it is of vital importance to anyone working in the field of medical entomology.

The book is well printed on good paper, the binding serviceable, and the illustrations clear and rather fully explained. Mistakes can be noted here and there, but on the whole they are few and not of importance.

ROBERT MATHESON

STRANGE VISITOR.

By Edith Farrington Johnston. The Macmillan Company, New York. $2.50. 72 pp.; ill. 1947.

Charmingly illustrated by the author and delightfully told, this story of the ways of *Paratenodera sinensis*, our naturalized Chinese praying mantis, is as fine a nature book for 8- to 12-year-olds as is to be found. Supplementary notes provided for parents at the back of the book testify to Edith Johnston's knowledge of her subject. This is the sort of book that impels the sole comment: Give us more of its kind.

BENTLEY GLASS

COLÉOPTÈRES CÉRAMBYCIDES DE L'AFRIQUE DU NORD. *Faune de l'Empire Francais, V.*

By André Villiers. Office de la Recherche Scientifique Coloniale, Paris; Éditions du Muséum, Paris; Librairie Larose, Paris. 300 fr. (paper). iv + 153 pp.; ill. 1946.

The insects of Africa and of the Pacific Islands are probably the most meagerly known portions of the world's entomological fauna. Consequently, any study that brings together information about them and adds to that store is more than welcome. Expecially is this true when the study is as scholarly and as thorough as the one here.

In the introduction, the external morphology of both adults and larvae are reviewed and illustrated, so that even untrained persons are enabled to use the well-composed keys to the various categories. In this section, too, there are brief notes on the economic aspects and zoogeography of the family in north Africa. While, as can be well supposed, many of the affinities of the cerambycids there are with southern Europe, some surprising relationships with central Eurasia and southeastern Africa are demonstrated.

In the systematic portion of the book, keys to the subfamilies, genera, and species are provided. Tribes, being rather superfluous in the present instance, are omitted. Each genus and species is briefly, but adequately, described, and most of the species are illustrated by well executed drawings made by the author himself. North African localities where collections of the species have been made are listed, and notes on general distribution are given under each form. Furthermore, notes on the ethology are briefly presented for each species. A total of 147 species in 68 genera is included. All in all, this is a fine example of the type of study still so greatly needed for many regions of the world, including many nearer the reviewer than north Africa.

LAWRENCE S. DILLON

STINGLESS BEES (MELIPONIDAE) OF THE WESTERN HEMISPHERE. *Lestrimelitta and the Following Subgenera of Trigona: Trigona, Paratrigona, Schwarziana, Parapartamona, Cephalotrigona, Oxytrigona, Scaura,*

and Mourella. Bulletin of the American Museum of Natural History, Volume 90.

By Herbert F. Schwarz, with a bibliography by Herbert F. Schwarz and Annette L. Bacon. The American Museum of Natural History, New York. $7.00 (paper). xviii + 546 pp. + 8 plates; text ill. 1948.

The title describes this remarkable work only in part, which is unfortunate, since it may discourage most biologists from further acquaintance. In fact, the first third of the volume is a masterly review of the natural history of stingless bees, of interest to many types of readers. Because the common stinging honeybees (Apidae) have been popular throughout the ages, many books describe their activities. Their stingless sisters, the Meliponidae, though more numerous in kinds and with equally fascinating habits, have been less fortunate, observations of their biology being fragmentary and widely scattered. Schwarz gives us the first adequate summary of the subject. Stingless bees are nowadays essentially tropical insects, but were more widely distributed during the Tertiary. Their nesting habits and social life depart in many respects from those of honeybees. Two types of cells are found in the nest, both built mainly of wax secreted dorsally by the abdomens of queen and workers, and possibly also of males. Honey and pollen are stored in special jars or pots, rather crudely shaped and either loosely or compactly grouped. Quite apart from these are placed the smaller brood cells, irregularly clustered in the more primitive species, in the others arranged in superposed horizontal combs or in one comb coiled in a continuous spiral. The brood cells, placed in a single layer, open upward and lack the geometrical regularity of the honeybee comb. While in the honeybees the larva is fed progressively by the workers, the Meliponidae practice mass provisioning. The completed brood cell is filled with honey and pollen, an egg is laid on top and the cell is sealed over. The larva has no contact with the outer world until the adult bee emerges from the cell. In *Melipona* cells for future queens do not differ from those producing workers or males; but in *Trigona* the "royal cells" are larger than the others. In stingless bees the differentiation between queen and worker may be due to factors other than nutritional ones. New colonies are started by swarming of parts of older colonies. Although the sting is atrophied and functionless, the Meliponidae are provided with other means of defense and even of attack. The account of Foraging will interest the ecological botanist. That of the Products of the Stingless Bees and Apiculture is very detailed. Meliponids occur in the tropics of both hemispheres; but their domestication has been attempted only in the New World, possibly because in the Old World honeybees proved more manageable and rewarding. The Maya Indians particularly have for centuries been proficient in the keeping of stingless bees, which are an important part of their economy, connected since ancient times with peculiar ceremonial rites. A survey of various unsuccessful attempts to acclimatize stingless bees in Europe concludes the general chapters.

The remainder of the volume is devoted to the classification, description, and distribution of the species of *Lestrimelitta* and certain subgenera of *Trigona* mentioned in the subtitle. Though no doubt mainly the meat of the specialist, this section gives many details of specific habits. Schwarz' work, the crowning product of twenty years of assiduous research, is taxonomy at its very best. I heartily recommend it as a model to the younger biologists for its broad outlook, precise methods, and painstaking care of detail.

J. BEQUAERT

THE MOLLUSCA OF THE NIAGARA FRONTIER REGION *and Adjacent Territory. Bulletin of the Buffalo Society of Natural Sciences, Volume 19, Number 3.*

By Imogene C. Strickler Robertson and Clifford L. Blakeslee. Buffalo Society of Natural Sciences, Buffalo. $3.50 (paper). xii + 191 pp. + 1 map; ill. 1948.

A ZOOGEOGRAPHIC STUDY OF THE LAND SNAILS OF ONTARIO. *University of Toronto Studies, Biological Series, Number 57.*

By John Oughton. University of Toronto Press, Toronto. $2.75 (paper). xx + 128 pp.; ill. 1948.

It is a strange coincidence that these two works should have appeared at the same time. Although they are not exactly comparable, they have so much in common that it is appropriate to cover them in a single review.

Mrs. Robertson has carefully sifted all the available literature of the past forty years for records of mollusca taken on the southeastern slope of the Niagara drainage system, and Blakeslee has just as carefully visited every locality mentioned earlier as well as numerous new ones, in order to make this search exhaustive. Their success is evident from the fact that 235 species and varieties are listed. Probably no larger number has ever been taken within an equal geographic area, even on the sea coast. Nearly every one of these is depicted on the four photographic plates.

In the systematic part of the book the name of each species is accompanied by a list of the localities where it has been taken, with the name of the collector if other than the authors. Then follows a list of localities arranged alphabetically, with annotations to help the collector. The bibliography contains the names of 32 authors, and the index covers eight pages.

Oughton's work is not confined to the Niagara area, but covers the entire Province of Ontario. It is restricted to the land snails, of which 89 are enumerated. For nearly every one there is a map of the province, showing the localities for which published records exist, or which are represented by specimens in the collection of the Royal Ontario Museum. Following this faunal list is a lengthy discussion of the zoögeography and

ecology of the Province. There is a bibliography of 135 authors, many of whom are represented by more than one publication, and records of the rates of locomotion of some of the commoner species.

Both these works will be of interest not only to the malacologist, but also to the student of the geographic distribution of animals.

JOSHUA L. BAILY, JR.

SEA-SHORE LIFE OF BRITAIN. *The British Nature Library.*

By L. R. Brightwell. B. T. Batsford, New York, Toronto and Sydney. $3.75. xii + 116 pp. + 36 plates; text ill. 1948.

Although attractively printed on a good grade of paper and illustrated with drawings, paintings, and photographs, this book appears to have been written in haste unbecoming to the publisher's efforts. The photographs of English seacoasts and beach scenes are excellent, but the author's drawings are too often slap-dash jobs characteristic of a student's notebook. Some of the many zoological errors in the book are the result of over-general statements or headlong syntax, while others seem to have been revived from Pliny. We learn with interest, for example, that the octopus stores crabs "among its coils," and removes meat from a crab "with the slender tips of its tentacles" (p. 66), and that *Dentalium* "begins life as a bivalve" (p. 25). It is particularly enlightening to learn that the hydroid medusa reverses itself and becomes fixed to give rise to the colony, thus constituting the alternation of generations (pp. 90–91). Most of these errors seem to be the result of the author's desire to be as popular and as painless as possible. This is dangerous when not supported by a thorough knowledge of the subject, and in this book it has also resulted in an oversimplification of morphology and classification distressing to a professional. Readers not familiar with the English fauna will find the general absence of scientific names a handicap, but the fine photographs of characteristic shores and beaches are a welcome feature.

JOEL W. HEDGPETH

PETIT ATLAS DES POISSONS. *III. Poissons des Eaux Douces: Espèces Françaises. Number 4. New Edition.*

By Fernand Angel. Éditions N. Boubée & Cie., Paris. 250 fr. (paper). 137 pp. + 16 plates; text ill. 1948.

PETIT ATLAS DES POISSONS. *IV. Poissons des Eaux Douces: Espèces Exotiques & d'Ornement. Number 4.*

By Fernand Angel. Éditions N. Boubée & Cie., Paris. 250 fr. (paper). 129 pp. + 12 plates; text ill. 1946.

Despite their modest title, these little books are surprisingly comprehensive. The "fascicule" on freshwater fish of France includes discussions of the environment, geographical distribution and fish-cultural methods, and gives precise descriptions, many of them accompanied by clear text figures, of the important and interesting species. There are also generic keys. The volume on exotic and ornamental fish is actually an aquarium guide, with information on plants, invertebrates, and procedure, as well as descriptions and notes on the biology of the small fish now familiar to amateur aquarists the world over. The color plates for both volumes are rather bold water colors, adequate for the purpose, and apparently well reproduced. Each book is supplied with indices to species and illustrations, and brief bibliographies.

JOEL W. HEDGPETH

WING-TIPS. *The Identification of Birds in Flight.*

By Roland Green. Adam & Charles Black, London. $1.75. 64 pp. + 4 plates; text ill. 1947.

The emphasis in this little book is on bird flight and the adaptations of the wing structure to the flying characteristics of various species. Illustrations by the author demonstrate flying patterns as well as the gross construction of the wing. Although a beginning student may get some benefit from this book, and although it should be emphasized that it is intended for bird lovers whose interest scarcely surpasses a friendly feeling for his feathered friends, still it could have been improved by additional bits of information and some rearrangement of material. Soaring, gliding, flapping, and hovering are mentioned but not adequately differentiated. From this description of flight types the topic switches to flight identification of birds of prey, ducks, and wading birds. This is followed by a brief and confusing page on the correlation between migration and wing pattern, and then successively by accounts of snipe, crows, and pelicans. There is no information about the mechanism of flight. The greatest value of this book lies in its illustrations of the flight markings of various English species of birds, belonging mostly to the groups already mentioned.

HENRI C. SEIBERT

A REVIEW OF THE AMERICAN MENHADEN, GENUS BREVOORTIA, WITH A DESCRIPTION OF A NEW SPECIES. *Smithsonian Miscellaneous Collections, Volume 107, Number 18, Publication 3913.*

By Samuel F. Hildebrand. Smithsonian Institution, Washington, D. C. Paper. ii + 39 pp. + 1 table; text ill. 1948.

A detailed taxonomic study of this commercially important genus, including a key to the species, written with the highest competence.

THE WAYS OF FISHES.

By Leonard P. Schultz, with Edith M. Stern. D. Van Nostrand Company, New York, London, and Toronto. $4.00. xii + 264 pp.; ill. 1948.

In spite of the fact that there are nearly twice as many kinds of fishes as there are of all other vertebrates, little information on the many interesting habits of this class is available to the general reader. With this in mind, Leonard Schultz has skilfully drawn upon a vast fund of material and put a large amount of such information within easy reach of the non-ichthyologist. In addition, numerous good sketches aid the reader to visualize the activities described. Included are chapters on feeding habits (such as the shooting of prey with water droplets by archer-fish), nesting, building, fighting, association with other animals, beach spawning, migration, and so on. Schultz has a pleasing style which, together with the other features noted, makes his book one to be recommended highly, particularly to biologists interested in the habits of animals.

The one serious criticism apparent to the reviewer is the inclusion, as an appendix, of a classification of fishes that is too formal to be intelligible to the general reader for whom the rest of the book has been so successfully planned.

JOHN E. CUSHING

THE AMPHIBIANS AND REPTILES OF ALTA VERAPAZ, GUATEMALA. *Miscellaneous Publications, Museum of Zoology, University of Michigan, Number 69.*

By L. C. Stuart. University of Michigan Press, Ann Arbor. $1.50 (paper). 109 pp. + 1 map; text ill. 1948.

Stuart's long range project is a geographic study of the herpetofauna of Guatemala. The Guatemalan Department of Alta Verapaz is a region of especial significance, in so far as the solution of broader zoogeographic problems in Central America is concerned. Stuart has brought back from Guatemala to the University of Michigan Museum of Zoology about 2200 specimens and these, plus material in other museums, form the basis of the present paper and a more extensive one still to follow. The latter is presumably to be largely zoogeographic in nature, whereas the one under review here is both introductory and systematic.

The paper will be of interest to two partially overlapping audiences. Herpetologists will welcome the systematic section, which is an annotated list of 136 species and subspecies of reptiles and amphibians. A synonymy of Alta Verapaz references, museum numbers of extant specimens, some habitat information, and, in the case of many of the snakes, scutellation data, comprise the usual annotations.

Others concerned with Central American zoogeography, regardless of primary systematic interest, will be thankful to Stuart for the compilation of a great deal of information in other sections of the report. There is a five-page historical account of the herpetological exploration of Alta Verapaz that includes mention of such explorers as Duméril, Morelet, Salvin, Godman, Bocourt, Berendt, and Sapper. There is also a discussion of the topography and a careful and rather detailed list of localities from which material has been collected. Accompanying this is a map of Alta Verapaz (done by the author under the pseudonym of Pancho M[atalaculebra]) showing his locations of many stations not hitherto plotted. The paper includes a half-dozen drawings of tadpoles, and closes with a list of literature (about 90 titles) and an index.

The present useful report might have been extended in at least two ways to be made more useful. In the first place, it is apparent that altitude and floral zones (which, of course, are related) are of the utmost importance in understanding the distribution of many of the forms considered, yet these data are not indicated in the map. (Such a map and appropriate photographs, it is understood, are planned for the larger report.) Secondly, the amount of information recorded for the snakes is not as inclusive as it might be, considering the space used in its presentation. A page-width table carries only four or five columns of data, of which two are the specimen's number and sex. Size is not recorded.

There is one serious typographical error to which attention should be directed. Table XXXV, showing the scutellation of *Bothrops mexicanus*, is placed under, and labeled, *B. nigroviridis aurifer*.

ARNOLD B. GROBMAN

LIFE HISTORIES OF NORTH AMERICAN NUTHATCHES, WRENS, THRASHERS AND THEIR ALLIES. ORDER PASSERIFORMES. *Smithsonian Institution, United States National Museum Bulletin 195.*

By Arthur Cleveland Bent. United States Government Printing Office, Washington, D. C. $1.75 (paper). xii + 475 pp. + 90 plates. 1948.

Number 16 in the now famous Bent series of Life Histories includes the families Sittidae (nuthatches), Certhiidae (creepers), Chamaeidae (wren-tits), Cinclidae (dippers), Troglodytidae (wrens), and Mimidae (thrashers). The nomenclature is based on the 1931 edition of the Check-List and subsequent supplements that have appeared periodically. Since the writer discusses the various subspecies separately (although the major emphasis and the greatest amount of data are naturally on the more wide-spread and better known races), the continual changes involved by the supplements must have kept him busy rearranging the manuscript until the printer's dead-line. However, the results are just about up to date. As is well known, these volumes are a cooperative undertaking, and several persons have contributed the major portion of the mate-

rial for the following species: white-breasted nuthatch, red-breasted nuthatch, and brown creeper, W. M. Tyler; wren-tit, M. M. Erickson; house wren and catbird, A. O. Gross; mockingbird, A. Sprunt, Jr. The same presentation is followed as in previous volumes, including the numerous illustrations of the birds and their habitats. Aside from the usual wealth of information and the inexpensive price, the extensive bibliography is an additional reason for every ornithologist to have this series within easy reach.

HENRI C. SEIBERT

REPORT ON COLLECTIONS OF BIRDS MADE BY UNITED STATES NAVAL MEDICAL RESEARCH UNIT NO. 2 IN THE PACIFIC WAR AREA. *Smithsonian Miscellaneous Collections, Volume 107, Number 15, Publication 3909.*

By Lt. Rollin H. Baker. Smithsonian Institution, Washington, D. C. Paper. ii + 74 pp. + 6 plates; text ill. 1948.

The Naval Medical Research Unit referred to in the title of this publication was interested in studying ectoparasites and this interest resulted in the collection of many land vertebrates. Approximately 1300 bird specimens were obtained, and these form the basis for this report. Collections were made at Espiritu Santo Island (New Hebrides); Bougainville and Guadalcanal (Solomons); Samar (Philippines); Okinawa (Riu Kiu); Guam and Rota (Marianas); Ulithi and Truk (Carolines); and in the southern group of the Palau Islands. Each collecting station has been indicated in a series of nine maps. Collecting was not carried on with the same intensity and for the same duration in all these areas, and consequently some are better represented than others. Some of the species, especially when a large series was obtained, are discussed in detail.

HENRI C. SEIBERT

VULPES THE RED FOX.

By John L. George and Jean George; illustrated by Jean George. American Woodland Tales: E. P. Dutton & Company, New York. $2.50. 184 pp.; ill. 1948.

Without any question, children of ages 10 to 16 years will thoroughly enjoy this book. In fact, it would not be surprising to see dad engrossed by it, too, after the younger generation has been packed off to bed. The brush illustrations have extraordinary life and charm, even exceeding the graphic descriptions and rapidly moving narrative of the text in appeal. The ways of the Eastern red fox are evidently well known to the authors, who have succeeded in creating a vivid animal personality that fully evokes the reader's sympathy.

There is, however, a dubious element in the tale. The human point of view is that of the hunter; and Vulpes the fox becomes a creature who thoroughly enjoys the dangers of the hunt, who challenges the dogs to trials of skill, and who ironically delights, up to the last fatal moment of his one mistake, in the delusions of the man with a gun or trap. Too many human thoughts run through Vulpes' brain and too many human emotions color his personality, for this to be good natural history. It stands, instead, among the better examples of animal fiction.

BENTLEY GLASS

TRACKS AND TRAILCRAFT.

By Ellsworth Jaeger. The Macmillan Company, New York. $3.95. x + 381 pp.; ill. 1948.

The presence of many animals in any area may be unsuspected until evidence in the nature of tracks, scats, burrows, etc., is discovered and identified. In most cases the identification requires considerable skill and experience, but with the aid of this book some of these interesting signs can be correctly interpreted. Although written for the tyro it crams sufficient information into its pages to satisfy even an experienced field man. One good feature of the book is its inclusiveness, both taxonomic and geographical. After a few chapters on fossil tracks, Indian tracks and signs, scent trails and blazes, the meaty portion of the book begins with a description of common backyard and barnyard tracks. The next three chapters are on animal tracks of field and forest, and are naturally the most important. Coyotes, wolves (whose tracks the writer honestly admits are difficult to differentiate from those of dogs), fox, bear, coon, weasel, skunk, otter, badger, the northern fur bearers, the coati, the ungulates and rodents, rabbits, armadillo, insectivores, and so on, are all described by their tracks and trails. Snowshoe trails of rabbit, grouse, ptarmigan, and Indians are the contents of the next chapter. This is followed by another full-sized chapter on the tracks of animals of jungle and zoo. This is a heterogeneous account, the animals having been selected rather indiscriminately, apparently because of their frequency in American zoos. One long chapter is on bird tracks. Other chapters deal with amphibians and reptiles, crustaceans, insects and mollusks, and still others on methods of reproducing tracks and various outdoor tracking games that can be played.

A large number of illustrations is required for a book of this nature and fortunately they have been supplied. There are 203 plates depicting various tracks and trail marks, each clearly showing the outlines of the tracks and other characteristic features or activities of the animals concerned.

All in all, this is a good book and the following comments are offered merely as suggestions. In several instances the size of the track has been omitted from both text and plate, and very seldom is there any

mention of the average length of stride. This information is often very useful. Scats are not mentioned, yet they are often unmistakable and easily seen. The experience of the reviewer with bird tracks has been that too much reliability cannot be placed on their identification, since the resemblance from one species to another is very close and only under perfect conditions can unmistakable prints be obtained. A comparison of several plates of bird tracks in the book will easily bear out this fact. Therefore a word of caution to beginning trackers would not have been out of place. There is an interesting comparison of the shapes of woodpecker holes, but no mention of their sizes. A few slips in scientific spelling: *Lynx ruffus* for *rufus;* Dromaidae for Dromaeidae; *tricilor* for *tricolor*. Finally, again as a suggestion, it might have been well to leave out the jungle and zoo section, and to reduce the size of the book so as to make it a little handier to slip into the pocket for on-the-spot reference. As it is, however, the book is heartily recommended to all out-of-door enthusiasts.

HENRI C. SEIBERT

ECONOMIC ZOOLOGY

THE HIVE AND THE HONEYBEE. *A New Book on Beekeeping to Succeed the Book "Langstroth on the Hive and the Honeybee."*

Edited by Roy A. Grout; assisted by The Staff of The American Bee Journal. Dadant & Sons, Hamilton, Illinois. $4.00. xx + 652 pp.; ill. 1946.

This textbook of beekeeping was written by 13 selected authorities in the many phases of the beekeeping industry and capably edited by Roy A. Grout, with the assistance of the editorial staff of the *American Bee Journal*. It was written to succeed the book *Langstroth on the Hive and the Honeybee*, portions of which are incorporated in the book. It is designed primarily for the beekeeper, fruitgrower, and seedsman, all of whom require the services of beekeeping. The book is divided into 25 chapters that deal separately with the latest information on the fundamental practices of beekeeping and of the beekeeping industry in its relation to agriculture. The history and the development of beekeeping, the anatomy and physiology of the honeybee, its biology and behavior and the latest manipulative practices for the production of honey, queen bees, package bees, and for the use of bees in pollination services are discussed at sufficient length to give the beekeeper or student of beekeeping a wide field of information. The various bee diseases are discussed as to symptoms and treatment. The origin and physical and chemical properties of honey, as well as methods of processing it for the retail or wholesale trade, are also considered. This is the latest and most comprehensive work on beekeeping and merits the serious consideration of all novice and professional beekeepers.

J. E. ECKERT

INSECT PESTS. *Second Edition.*

By Wm. Clunie and Harry Hill. Paul B. Hoeber, Medical Book Department of Harper & Brothers, New York and London. $5.00. xii + 347 pp. + 2 plates; text ill. 1948.

This book is entirely devoted to a discussion of insect pests that affect man and his stored foodstuffs. It is divided into two parts: Part I, devoted to a discussion of the pests with a brief preliminary chapter on insects in general (pp. 3–128); Part II, an extended discussion of methods and procedures in insect control (pp. 131–317). Two brief appendices and an index complete the book. There is no list of references. The first part of the book consists of chapters on The Bed-Bug, The Flea, The Louse, Mosquitoes and Moths, and Other Insect Pests. These chapters are readable and, for the most part, quite accurate, though not up-to-date in some respects. The recommendations given here for control of these pests are mostly of the old-fashioned types, although in the second part of the book the newer methods of treatment are quite fully elaborated. The book could be improved by concentrating the first part on the biology, habits, distribution, and other factors in the life-cycles of these pests, and reserving discussion of control measures for the second part. In the discussion of mosquitoes none of the newer repellents are mentioned, and some of the old mixtures, of little value, are still recommended.

The second part begins with a discussion of building procedures so as to reduce all cracks, crevices, shrinkage, and faulty construction in order to eliminate hiding places for pests, especially in apartments and low-cost dwellings. The suggestions are particularly adapted for European workmanship, but more attention should be paid to these details in America. Our architects and builders would do well to study similar procedures and thus reduce the cost of eventual pest control operations. Following this comes a detailed description of the various insecticides and how they may be employed. Fumigation with gases is given in full detail, as well as the ways of using the other important insecticides. As usual, an entire chapter is devoted to the wonders of DDT. There are also chapters on educational measures, legislative controls, disinfestation of foodstuffs and ships, and finally a good chapter on human toxicology.

This book is a handy reference work for all those responsible for sanitation, even though the directions apply mostly to conditions in England. Much of the discussion and many of the recommendations might well be studied to meet conditions in our own and other countries. The book should prove a valuable aid to

our many pest control operators. Unfortunately, the few illustrations are not all they should be.

ROBERT MATHESON

GALL MIDGES OF ECONOMIC IMPORTANCE. *Volume III: Gall Midges of Fruit. Agricultural and Horticultural Series.*

By H. F. Barnes; foreword by A. M. Massee. Crosby Lockwood & Son, London. 15s. 184 pp. + 9 plates. 1948.

This volume consists of detailed accounts of the biologies of fruit-gall midges with accurate descriptions of their effects on their hosts. In the beginning there is a list of 47 fruits, each with its known gall midges and the part injured. These are all discussed in the main body of the work. The arrangement is most satisfactory, for the reader can choose any fruit, glance down the pages to locate it and find there a list of known midges from all the world with page references to the detailed accounts of the various species. Furthermore, under the discussion of each species the author has very obligingly given the most important references dealing with it. Could anyone ask more? The book is most delightfully written, and the reader may learn much that is new to him about the various fruits. In addition, the control of these midges by their parasites is given proper weight, besides full accounts of the known control measures by the use of insecticides, agricultural practices, or other means.

This book should certainly find a place on the reference shelf of every fruit grower, for it will enable him to learn to note these peculiar growths and their effects on his fruits. To the entomologist the book should prove an excellent guide, inasmuch as most of these gall midges can be recognized by their work, whereas the identification of the midges themselves might prove extremely difficult.

An added attraction is a bibliography of 467 titles, a list of midges (scientific names), and an index. The book is well printed, the photographs are clear, and the binding is a nice red (suitable for *fruits*). The reviewer can heartily recommend it to anyone interested in fruits—and who is not?

ROBERT MATHESON

SEAFOOD SHIPS.

By A. C. Hardy. Crosby Lockwood & Son, London. 12s. 6d. 248 pp. + 31 plates + 1 chart; text ill. 1947.

Relatively few people are acquainted in any detail with the great economic value of fish products or of the tremendous and varied effort put forth by fishermen to obtain them. This book brings together a vast amount of information on this industry, amounting to a world survey. Its organization is best seen by noting the parts: The Catch; The Catchers; The Fishing Nations and Communities; The Story in Brief (a family tree of types of fishing ships). While a book of this scope must be superficial to remain of reasonable size, Hardy has succeeded in providing a good source from which to learn of the great complexity to which modern fishing ships have evolved and to observe the diversities imposed upon this evolution by the specific requirements of particular fisheries. Some parts of the text suggest that further polishing of the style might have improved them, but this point does not seriously detract from the favorable features of the book. Many illustrations are provided in the form of drawings and photographs. These include a series of interesting profiles of fishing ship types by Laurence Dunn.

JOHN E. CUSHING

HISTORY, DEVELOPMENT, AND PROBLEMS OF ELECTRIC FISH SCREEN. *Special Scientific Report Number 53. By Harlan B. Holmes. United States Department of the Interior, Fish and Wildlife Service, Washington, D. C.* Paper. ii + 62 pp. 1948.

The efficacy of electric fish screens still remains to be demonstrated, especially where migratory fish are concerned, and this report seems to be intended as preliminary to an adequate program of testing rather than as a thoroughly factual contribution to the subject.

ANNALES BIOLOGIQUES. *Volume Number III, 1946. Conseil Permanent International pour l'Exploration de la Mer.*

Edited by H. Blegvad with the assistance of A. J. C. Jensen. Andr. Fred. Høst & Fils, Copenhague. Kr. 12.00 (paper). 115 pp.; ill. 1948.

NORTH-WESTERN AREA COMMITTEE, REPORT OF THE SUB-COMMITTEE ON FAXA BAY. *Rapports et Procès-Verbaux des Réunions. Volume CXX. Conseil Permanent International Pour l'Exploration de la Mer.*

Edited by Â. Vedel Tåning. Andr. Fred. Høst & Fils, Copenhague. Kr. 14.00 (paper). 129 pp.; ill. 1948.

The first of these two publications consists of summaries and condensed data of hydrographical conditions and fisheries investigations in the North Sea, Baltic, and Iceland areas, primarily for the year 1946. The report on Faxa Bay is concerned with the question of the closure of that nursery ground on an experimental basis and includes 26 separate papers, most of them written before the war, on various aspects of the problem. These two publications are ample evidence that the International Counsel has recovered from the interruption of the war years and is carrying forward its work in a competent, satisfactory manner.

JOEL W. HEDGPETH

THE COMMERCIAL FISH CATCH OF CALIFORNIA FOR THE YEARS 1945 AND 1946. *Fish Bulletin Number 67.*

By the Staff of the Bureau of Marine Fisheries. Division of Fish and Game, Bureau of Marine Fisheries, State of California Department of Natural Resources. Paper. 80 pp.; ill. 1947.

ESTIMATION OF THE TROLL CATCH OF COLUMBIA RIVER CHINOOK SALMON, ONCORHYNCHUS TSCHAWYTSCHA. *Special Scientific Report Number 50.*

By Ralph P. Silliman. United States Department of The Interior, Fish and Wildlife Service, Washington, D. C. Paper. ii + 15 pp. + 18 charts. 1948.

FRIENDLY ANIMALS.

By Karl Patterson Schmidt; illustrated by Percy Reeves. M. A. Donohue & Company, Chicago and New York. $1.50. 64 pp. + 12 plates. 1947.

Schmidt presents the story of the origins of eight familiar domestic animals as reconstructed by means of fossil remains and ancient writings and drawings. He includes in each instance their geographic distribution and the uses to which man has put them throughout the centuries. The animals thus described include the dog, the cat, cattle, sheep, tame and wild goats, the horse, the donkey, and both domestic and wild swine. The book is beautifully illustrated with full-page color drawings by Percy Reeves. The artist depicts both the original wild and present tame or domestic form of each of the animals discussed. *Friendly Animals* should be of particular interest to the junior high school and high school age group.

W. D. McELROY

ANIMAL GROWTH AND DEVELOPMENT

CONTRIBUTIONS TO EMBRYOLOGY. *Carnegie Institution of Washington Publication 575, Volume XXXII, Numbers 207 to 212.*

Carnegie Institution of Washington, Washington, D. C. $9.00 (cloth); $8.50 (paper). iv + 261 pp. + 56 plates; text ill. 1948.

The present volume of *Contributions to Embryology* contains six papers, four of which are concerned with some phase of human development and are based primarily on the material of the large and excellent Carnegie Embryological Collection. Several years ago, it will be recalled, the late distinguished embryologist Dr. G. L. Streeter, upon his retirement as Director of the Carnegie Embryological Laboratory, undertook the important and monumental task of preparing an improved list or catalogue of human developmental stages. His plan was to segregate the large collection of embryos of the first seven weeks of development into groups or periods representing levels in their structural organization as a whole. These age groups he designated as "Developmental Horizons" and contemplated some twenty-five such groups. It was found that at any one of the demarcated horizons the growth and differentiation of the various body tissues and organs conform to a definite pattern characteristic for that particular level of development. In other words, there is at each respective level a syndrome of characters the presence of any one of which portends the existence of the others. So precisely, then, does organogenesis fit into a timed sequence that by determining the developmental status of any one organ of the syndrome, such as the kidney or membranous labyrinth, for example, it is possible to foretell the developmental status of all the other organs of that particular specimen, i.e., to reconstruct the whole embryo. In pursuing his study, Streeter very wisely gave special consideration to those characters that can be clearly and easily recognized without special staining techniques or elaborate reconstructions. The value of this is readily seen: by surveying the serial sections of any new embryo one would be able in a relatively short time to ascertain its proper developmental horizon and its ovulation age. (The ovulation age of the various age groups was determined by comparison with macaque embryos of known ovulation age having a similar degree of development. This undoubtedly gives a better approximation of the true age than the confusing data usually afforded by the clinical histories of the specimens.) So far, two issues of Streeter's exceedingly beautiful and carefully worked out study, including the four developmental horizons XI–XIV, have appeared in volumes 30 and 31 of the *Contributions to Embryology*. In the present volume the succeeding four horizons, XV–XVIII, are added. It is to be deeply regretted that Streeter was not spared to complete this important study which he pursued with such devotion and enthusiasm. This reviewer joins with other embryologists in the earnest hope that someone of Streeter's capable associates will see this valuable work through to completion.

The second paper dealing with human development is a detailed account of the development of the cranial arteries, by Dorcas Hager Padget. This study is based on graphic, profile reconstructions of 22 sectioned embryos ranging from 3½ weeks (20 somites) up to 7½ weeks, when the definitive adult origin of essentially all of the cranial arteries is established. One cannot examine the 48 beautifully executed drawings which illustrate the text and were prepared by the author herself without being greatly impressed by the tremendous amount of careful and painstaking research that such a study entails.

The two other papers concerned with human material are by Emil Witschi and Joseph Gillman, respectively. Witschi's paper deals with the migration of the germ cells from the yolk sac to the primitive gonadal folds of embryos ranging from the 13-somite to the 8-mm. stage. It appears that in the human, as in certain

other vertebrates, the primordial germ cells originate outside the gonadal area and later reach the gonad primordia by autonomous migratory movements. In his investigation Witschi has found no facts and no theoretical arguments in favor of a secondary germ-cell formation. "The germ cells are strictly specific and do not change into somatic elements."

Gillman's paper deals with the development of the gonads, with the role of fetal endocrines, and with the histogenesis of ovarian tumors. His study, based on the examination of a tremendous amount of material, is divided more or less into three parts: (1) descriptions of gonad development; (2) an analysis of theories connected with the origin of the germ cells and other gonadal constituents; and (3) physiological considerations affecting the growth and differentiation of the sex glands.

Of the two remaining papers of this volume, one by Harold Speert is concerned with the mammary gland of the rhesus monkey; the other, by George W. Corner, is a study of the distribution of the enzyme alkaline phosphatase in the ovarian follicle and corpus luteum. Speert describes the normal development of the mammae in the embryo, newborn, adolescent, and adult rhesus, including cyclic changes. A good portion of the paper is concerned with changes occurring under a variety of experimental conditions. He discusses castration effects, hormonal effects, etc. One interesting point that might be mentioned here is that his observations show that the estrogens produce their trophic effect upon the mammary gland by direct action and not through pituitary mediation.

Corner's paper is of particular interest and significance in that it gives a new approach to an old problem, that of the origin of the corpus luteum. Using Gomori's method, Corner has studied the distribution of alkaline phosphatase in mature ovarian follicles and early corpora lutea of 6 species (pig, rabbit, guinea pig, dog, rhesus monkey, human). In order to use the phosphatase content of the theca interna as a means of following the fate of its cells in the corpus luteum, it is necessary, as Corner points out, that the granulosa cells be free of phosphatase and that the theca cells not only contain it, but retain it during conversion of the follicle into the corpus luteum. Of the species examined, these conditions prevail only in the pig.

In accord with the usual custom of this publication, the papers are very beautifully and very abundantly illustrated. Altogether, there are 57 plates and 52 text figures.

MARY E. RAWLES

FUNDAMENTALS OF HUMAN REPRODUCTION. *McGraw-Hill Series in Nursing.*

By Edith L. Potter; illustrated by Alvin W. Meyer, edited by Lucile Petry. McGraw-Hill Company, New York, Toronto, and London. $3.50. xii + 231 pp. + 12 plates; text ill. 1948.

A more dramatically and enthusiastically presented story of the development of a human organism is unknown to me. The story begins with the general pattern of reproduction, exemplified by several very different organisms, passes on to the general plan of reproduction and development of the human species, and ends with a survey of the origin and elaboration of each of the various organs of the body.

Any literate person with an intelligent curiosity, regardless of his educational training, will probably find the book interesting and will want to read it from cover to cover. The cleverly executed and clear diagrams accompanying the text are as interesting and edifying as the story they have been used to illustrate. Some excellent photographs of 5 to 34-week-old embryos further add to the value of the book. A few factual errors occur in the text and diagrams, but these are not particularly significant and do not detract greatly from the book.

N. T. SPRATT

THE BIOLOGY OF MELANOMAS. *Being the Results of a Conference on The Biology of Normal and Atypical Pigment Cell Growth; Held by the Section of Biology of The New York Academy of Sciences, November 15 and 16, 1946, New York City. Special Publications of The New York Academy of Sciences, Volume IV.*

By Myron Gordon, Glenn H. Algire, S. William Becker, Harold F. Blum, Liane R. Brauch, E. A. Sheremetieva-Brunst, V. V. Brunst, Dean Burk, Gladys Cameron, Graham Phillips DuShane, Frank H. J. Figge, Clara E. Fischer, Denis L. Fox, Samuel A. Goldberg, C. G. Grand, Jesse P. Greenstein, James B. Hamilton, R. G. Harrison, Marie L. Hesselbach, M. J. Kopac, Frances Y. Legallais, Michael Levine, Eleanor J. Macdonald, Madge Thurlow Macklin, Howard S. Mason, P. Masson, J. M. Odiorne, George T. Pack, Elizabeth S. Russell, W. L. Russell, Leonell C. Strong, Kanematsu Sugiura, Helenor Campbell Wilder, and B. H. Willier. The New York Academy of Sciences, New York. $5.00. xii + 466 pp. + 107 plates; text ill. 1948.

As pointed out by Ross Harrison in the Introduction, the conference on The Biology of Normal and Atypical Pigment Cell Growth was definitely "a most timely one in bringing together a large mass of information bearing on the pigment problem." All the aspects, genetic, embryological, cytological, chemical, and physiological, were covered by specialists in the several fields. For example, G. P. DuShane presented a paper on The Development of Pigment Cells in Vertebrates and George Pack gave one on A Clinical Study of Pigmented Nevi and Melanomas, while Jesse Greenstein covered the Chemistry of Melanomas. A mere compilation of such information could be accomplished

by a series of review papers, but the critical evaluation of this material comes from the questions, criticisms, and general discussion by the many workers in each of these fields present at such a conference.

The papers presented at this conference are printed in *The Biology of the Melanomas*, a special publication of the New York Academy of Science which sponsored the meetings. The title of the conference would be more suitable for the book, since it includes as many papers on normal pigment cells as on tumorous ones. Most of the material has been covered more extensively and critically in scattered reviews, but in no single publication has information about so many different aspects of the problem been brought together before. However, the critical evaluation of the material, one of the achievements of the conference, is definitely lacking, since very few of the questions and discussions have been included in the publication. Samuel Goldberg's paper, The Melanoblast as a Mesodermal Cell, provides an incongruous touch, in view of all the experimental data presented that indicate beyond a doubt an ectodermal origin of these cells.

It is gratifying that all this information is now available in printed form for those who were unable to attend the meetings, and as a record of the level of knowledge of pigment cell growth in November, 1946.

ALICE BAKER

ANIMAL MORPHOLOGY

ORGANIC FORM AND RELATED BIOLOGICAL PROBLEMS. *By S. J. Holmes. University of California Press, Berkeley and Los Angeles.* $5.00. viii + 169 pp. 1948.

This volume of essays covers a wide variety of important topics, all of which are connected in one way or another with the general theme of differentiation and the development of body form. Typical chapter headings include: Building Through Functioning; Divergent Differentiation; Chemical Equilibrium; Regeneration of the Blood and Its Bearing on Morphogenetic Theory; Cancer as a Biological Problem; and Recapitulation and Its Supposed Causes.

The material is presented in a readable form with a minimum of technical terms. Matthew Arnold himself could not have desired a better example of sweetness and light in the handling of a series of subjects every one of which is still controversial. It is also a pleasure to find no tendency on the part of the author to slide off into either mysticism or sociology. (Perhaps this is no coincidence.) Occasionally there is some quiet humor, as when the author reminds his reader that, Dr. Child notwithstanding, there are real differences between a primitive tribal chieftain and the dominant end of a planarian. Some chapters, e.g., those on Genes versus Gradients and on the Origin of Life, are not entirely up to date in all respects; but even these mention the *Neurospora* work, though with great brevity.

Uniformly throughout the book a well-rounded view is given of each problem, with more emphasis than is now fashionable on the work and ideas prevalent at the turn of the century. Probably this is as it should be, for that was the generation (as the establishment of Roux' *Archiv* in 1895 testifies) which formulated most of the problems of developmental mechanics we are still attempting to solve.

The book could serve as a nucleus around which to organize a series of informal discussions for first-year graduate or advanced college students, but it appears to be intended primarily for intelligent laymen who wish to learn something of the problems discussed. There is a bibliography stressing books and review articles.

GAIRDNER MOMENT

A METHOD OF ANATOMY. *Descriptive and Deductive. Fourth Edition.*

By J. C. Boileau Grant. The Williams & Wilkins Company, Baltimore. $7.00. xxiv + 852 pp.; ill. 1948.

This textbook first appeared in 1937 and, although not intended as a dissector's manual, has since proven popular as a practical guide for learning the structure of the human body. "As a working instrument designed to make Anatomy rational, interesting and of direct application to the problem of medicine and surgery," it can be recommended. In this 4th edition 68 new illustrations have been added, bringing the total up to 800 original diagrammatic text figures. Bold type has been used more freely than in former editions and, to make for ready reference, headings and subheadings have been added widely throughout the text. However, it contains no bibliography and relatively little attention is given to allied sciences such as embryology, comparative anatomy, and the like. Thus it is of limited value to the more serious student of anatomy. It is, nevertheless, an ideal supplement to the excellent atlas by the same author.

DAVID B. TYLER

BAILEY'S TEXT-BOOK OF HISTOLOGY. *Twelfth Edition. Revised by Philip E. Smith and Wilfred M. Copenhaver. The Williams & Wilkins Company, Baltimore.* $7.00. xx + 781 pp. + 20 plates; text ill. 1948.

This 12th edition of the well-known 44-year-old textbook has been revised by Smith and Copenhaver. In it will be found many new illustrations executed by Mr. Carl Kellner, bringing the total to 455 figures, a number of them in color. Some changes will be found in the book, and a few sections have been rewritten with the purpose of correlating structure and function wherever

possible. As in the past, the authors have kept in mind the needs of first year medical and dental students and have avoided, where necessary, points of disagreement in presenting controversial subjects. Bibliography is limited to a few references at the end of each chapter, selected by the authors primarily as sources for other important references.

DAVID B. TYLER

A TEXTBOOK OF HISTOLOGY. *Fifth Edition.*
By Alexander A. Maximow and William Bloom. W. B. Saunders Company, Philadelphia and London. $8.50. xii + 700 pp.; ill. 1948.

No book in its field sets a higher standard of excellence in format, illustration, or text than "Maximow and Bloom." Hence each new edition is a notable event (see QRB 17: 373, 1942, for review of fourth edition). It is enough to say that the fifth edition surpasses the earlier ones in all these respects. The format has shifted to the use of double columns. The illustrations are amplified by the addition of 5 new figures in color and a number of autoradiographs, electron micrographs, and phase contrast photomicrographs. The section on protoplasm has been considerably revised and a part on its submicroscopic constitution added, by William L. Doyle. Clayton G. Loosli has rewritten the description of the respiratory portion of the lung. The chapter on bone has been rewritten in collaboration with Franklin C. McLean. Other changes occur in the discussions of muscle, endocrine glands, and the female reproductive system; and the sections on the hemopoietic tissues and on nervous tissue have been condensed. It is a genuine pleasure to inspect, and even more to use, such a book.

BENTLEY GLASS

NEUROANATOMY. *Second Edition.*
By Fred A. Mettler. The C. V. Mosby Company, St. Louis. $10.00. 536 pp.; ill. 1948.

The first edition of this textbook, which appeared in 1942, impressed the professional reader with its superb illustrations and its difficult text. The second edition has been revised and enlarged to the extent of sixty pages of text and twenty figures. The latter, both half-tones and schematic drawings, are well thought out and beautifully executed, although certain of the half-tone drawings do not reproduce so well as in the earlier edition.

Major additions have been made to the text in the discussions of the vascular supply of the brain and spinal cord, of the fiber projections and functions of the cerebellum, and of the nuclei of the thalamus and their connections, both corucal and subcortical. In contrast, the consideration of the cerebral cortex is again limited to the projection of the sensory systems and to the mechanisms of the direct control of motor activity. The author has nothing to say about the association areas of the frontal, parietal, temporal, and occipital lobes. The treatment of the reticulo-spinal system and of the cell groups of both dorsal and ventral horns of the spinal cord is inadequate, in view of recent research on these areas.

The book as a whole deserves much favorable comment. It is well organised and superbly illustrated, and many data from the experimental literature are found in the discussions. It is unfortunately a compromise between a textbook for beginning and one for advanced students of neurology. The details are too numerous and the writing too difficult for the former, while the discussions of the research literature are incomplete for the latter, being smoothed-out versions rather than a full consideration of the data and authors cited.

JAMES M. SPRAGUE

FUNCTIONAL NEURO-ANATOMY.
By A. R. Buchanan. Lea & Febiger, Philadelphia. $6.50. 242 pp.; ill. 1948.

The field of neuroanatomy is already covered by a large number of texts now published in this country, each designed for use by college undergraduate or medical students. The arrival in this well-exploited field of a new textbook covering the same ground would be a notable event only if it were exceptionally fine or written from a radically different point of view. The present volume meets neither of these requirements, being simply another routine presentation of neuroanatomy.

Although the preface states that reference to the literature has been kept to a minimum in the book, there is considerable text reference, particularly to recent papers. The practice of quoting recent work is commendable but involves the ever-present danger of attempting to interpret the central nervous system on the basis of new findings without balancing them against the weight of previous evidence gathered over many years. Buchanan tends, especially in Chapters V and VI, which deal with the spinal cord, to evaluate recent findings, some of them rather radical, as established fact, much of which is contrary to prevailing, classic conceptions. Neuroanatomical concepts change slowly, and only rarely can they be altered safely on the basis of single investigations.

The clinical illustrations of motor pathway and cerebellar lesions are faithfully presented; but they cannot be interpreted clearly in terms of the anatomy previously described. Simpler cases amenable to discrete anatomical interpretation would be more helpful to the student.

The illustrations by Miss Stevic are clear-cut and beautifully drawn. However, many of them have been

simplified in part, in order to emphasize particular structures. This is especially regrettable in the failure to distinguish clearly between the ventricular system and the cerebral fissure, in many of the figures.

The final chapters, on discrete topics such as the cerebrospinal fluid, vascularization, and interstitial tissue, are characterized by excellent choice of material and reliable criteria from related fields. The brevity of the volume as a whole is a distinct asset in a field in which the textbooks run to length. No cardinal fault can be found with this book, even though it suffers somewhat by comparison with other textbooks in the field.

F. N. Low

BRAIN AND INTELLIGENCE. *A Quantitative Study of the Frontal Lobes.*

By Ward C. Halstead. The University of Chicago Press, Chicago. $6.00. xiv + 206 pp. + 1 plate; text ill. 1947.

The author of this volume has attempted, on the basis of human material, to isolate basic factors of the general phenomenon called intelligence. For such a study to be an advance in our thinking about intelligence, these factors should not only be significant but also definable in biological terms, and they should lend themselves to animal experimentation.

The author has examined, over the period of 12 years preceding this publication, a large number of subjects—normal, brain-injured, and brain-operated. This study concerns 237 of them. They were subjected to a battery of psychological and physiological tests, mostly postoperatively in those undergoing neurosurgery, but in some both before and after operation. The operations involved frontal, parietal, temporal, occipital, and rhinal areas of the brain, and were performed by the neurological staff of the University of Chicago. The excellence of this group of surgeons, coupled with the thoroughness and objectivity of Halstead's examinations, form an impressive combination. The data obtained from 13 of the tests used by the author were subjected to factoral analysis independently by Holzinger and Thurstone, and four distinct factors were recognized by each. Halstead's study thus appears to be based on the best available techniques of operation, testing, and mathematical treatment of the data.

The four factors, called by the author C, A, P, and D, were first isolated from the test scores of a group of 30 normal subjects. C represents the organized experience of the individual, a coalescence of learning and "adaptive intelligence"; A involves the comprehension of essential similarities and dissimilarities; P is the actual power of the brain; and D constitutes the medium (for example, speech) through which the other factors are externalized at any moment. The impairment index of these factors was studied in patients after various brain ablations. Impairment was present following all types of cortical removal, but was twice as high in those suffering from damage to the frontal areas. Thus two main points emerge from this study.

(1) On the basis of performance in a number of psychological tests, four distinct factors can be discerned in normal subjects by the method of factoral analysis; and
(2) The integrity of these factors is dependent on the entire cerebral cortex, and particularly upon the frontal lobes.

It is essential that the study of intelligence should go beyond Thorndike's definition of intelligence as "that which intelligence tests measure." Basic factors must in some way be *defined* and *measured* by standards other than impressions and preconceptions. The author's emphasis on quantitative measurements is commendable, but he is not convincing as to what he is measuring. He says in his discussion of the method of factoral analysis, "There can be little doubt that the best of these devices can yield fairly reliable measures of something, but of what?" (p. 12). That his analysis (and naming) of his quantitatively discerned factors is not free from preconceptions is clear from the discussion of test 2 (p. 59). Here he argues that "the ability to carry out such tasks has long been known in psychology as the ability for abstraction. Since this ability is a prime requisite for successful performance on test 2, it would appear justifiable to identify it as a 'factor of abstraction' or the A factor."

The neuroanatomist and neurophysiologist, as well as the general biologist, will regret the frequent use of a psychological jargon, the words of which cannot be biologically defined. From the same point of view, the description of the tests is too brief and too technical. Most readers will object to the statement in the preface that "there are more than enough brain-injured people in the modern world to permit resolution of every fundamental question concerning the human mind, could this material be brought under adequate study."

The author has chosen one of the most important and most difficult problems of biology, and too much criticism of his failings on points where others have failed before him, would be reprehensible. It is too early to judge the value of his work, but he has submitted a thesis based on long and careful effort.

James M. Sprague

A TEXTBOOK ON PATHOLOGY OF LABOR, THE PUERPERIUM AND THE NEWBORN. *Second Edition.*

By Charles O. McCormick. The C. V. Mosby Company, St. Louis. $8.50. xxiv + 514 pp.; ill. 1947.

This is the second edition of an established textbook on abnormal labor. It is unchanged in style, emphasis, or format. It continues, therefore, as a conservative,

didactic, and quite complete presentation of sage clinical advice on the subject. The author is well-known as an obstetrician and an effective teacher.

There are eleven chapters which cover three main subjects: Pathology of Labor; Pathology of the Puerperium; and Pathology of the Newborn. The principal revision is in the illustrations. Ninety-one new ones have been added, ten of them in color, and eleven of the old ones were redrawn. One of the chief virtues of this book is its total of two hundred and seventy-two illustrations in the space of five hundred pages. The format of the text is synoptic, with little rounded discussion of the points under consideration. Paradoxically, this is both a virtue and a fault. For senior students in obstetrics, it is a nice compendium of valuable information; for obstetricians in practice, it is a ready reference and guide. But both should be aware of the fact that this book does not deal adequately with causes and mechanisms, and it is inadequate in the treatment of certain topics. The discussion of obstetrical anesthesia and analgesia is neither modern nor adequate. The treatment does not help an obstetrician to decide what forms of anesthesia or analgesia are preferable in particular situations. The author recognizes that x-ray pelvimetry is an important obstetrical aid, but he does not describe adequately the technics or applications involved. Again, the problem of the management of labor in very obese patients is not presented as a problem, which it all too often is. Such faults are small, however, in relation to the value which this book clearly has for physicians who must practice obstetrics under the conditions that prevail in most places throughout the United States today.

S. R. M. REYNOLDS

GYNECOLOGICAL AND OBSTETRICAL PATHOLOGY *With Clinical and Endocrine Relations. Second Edition.*

By Emil Novak. W. B. Saunders Company, Philadelphia and London. $7.50. xiv + 570 pp.; ill. 1947.

The second edition of this important textbook continues the tradition established by the first one. It is a most complete descriptive account, fully illustrated, of the important features of gynecological and obstetrical pathology. It is written in a clear, authoritative style which sorts, catalogues, and defines the lesions associated with the female genital tract. It is this which makes it a notable book to be valued highly by all students and practitioners of gynecology and obstetrics. The descriptive pathology is set against an account of the normal histology and appearance of the tissues concerned. This, too, is narrated with that simplifying, analytic exposition for which Emil Novak is so famous. It is, however, too simple, too brief, and too didactic for the critical reader, and the uncritical reader should be cautioned against relying wholly upon this account for his comprehension of the physiological mechanisms concerned in the physiology of reproduction.

S. R. M. REYNOLDS

ANIMAL PHYSIOLOGY

INTRODUCTION TO PHYSIOLOGY.

By W. H. Newton. The Williams & Wilkins Company, Baltimore. $2.50. 284 pp.; ill. 1948.

This is a little book with a big objective, yet one which it definitely achieves. It is intended by its author to be, particularly to beginning students, an introduction to a great subject. Most textbooks in physiology are enormous assemblages of facts in which the idea of the unity of the body is lost to one commencing a study of the subject. "It is," Newton says, "impossible to grasp this idea of unity of body function without a knowledge of the working parts, and so a vicious circle exists. The object of this small book is to break the circle by displaying the body working as a whole right from the outset, and placing the first details in perspective against this background."

To accomplish this end, a logical organization of the subject is developed. Familiar similes of energy production and fuel consumption in engines are set forth and compared with similar phenomena in the body. The relations of these to body temperature, comfort, clothes, and climate are described. This discussion leads to a consideration of the mechanism of nervous activity and of central control and the organization of the nervous system. Such is the pattern of the book. Problems of muscular control are discussed in relation to the nervous system on one hand, and to circulation of blood, oxygen transport, carbon dioxide production, transport, and elimination, and the respiratory tract, on the other. The remainder of the text places in logical order "the first details" of nutrition, digestion, intermediary metabolism, endocrine organs, reproduction, and finally, completing the circle of unity of body function, to a discussion of sense organs and the brain.

This book is written by an expert teacher who writes in an interesting style. He has himself drawn almost all of the 113 figures which amplify the text, and he never loses sight of the objective he has in mind or the level of his audience. This, it is clear, may well be of value to beginning medical students, teachers, and students of physiology in colleges, nurses, students of physiotherapy, and, to a limited degree, to general readers.

S. R. M. REYNOLDS

OUTLINE OF PHYSIOLOGY. *Second Edition.*

By William R. Amberson and Dietrich C. Smith; illustrated by Norris Jones and William Loechel. The

Williams & Wilkins Company, Baltimore. $5.00. xii + 502 pp.; ill. 1948.

This new edition of a beautifully illustrated textbook for beginning college students will be welcomed by teachers of physiology. Contrary to the authors' apprehension, and despite the addition of much new and more complex material, they have succeeded in maintaining the simple and yet comprehensive presentation characteristic of the first edition. Several new chapters covering catalysis, enzymes, vitamins, sensation, and heart have been added to appropriate sections, and a number of old chapters have been rearranged.

One outstanding feature of the first edition was the inclusion of many fine original illustrations prepared by the late Mr. Norris Jones. These will still be found in the revised edition, supplemented by well executed new illustrations by William Loechel and Robert Brown. This revised edition should prove as popular as the first with both teacher and student alike.

DAVID B. TYLER

A LABORATORY MANUAL OF PHYSIOLOGY *For Veterinary Students. Third Edition.*

By Clyde F. Cairy. Burgess Publishing Company, Minneapolis. $3.00 (paper). viii + 191 pp.; ill. 1948.

A revised edition of a manual of laboratory procedures and experiments, modified to meet the needs of veterinary students. Experiments on some aspects of endocrinology and reproduction have been added to this edition.

DAVID B. TYLER

PHYSIOLOGY OF EXERCISE.

By Laurence E. Morehouse and Augustus T. Miller. The C. V. Mosby Company, St. Louis. $4.75. 353 pp.; ill. 1948.

A textbook designed for those who have only an elementary knowledge of chemistry and physics, and for students of physical education. It contains a glossary, is well indexed, and bibliographies are found at the end of each chapter.

DAVID B. TYLER

FATIGUE AND IMPAIRMENT IN MAN.

By S. Howard Bartley and Eloise Chute, with a foreword by A. C. Ivy. McGraw-Hill Company, New York and London. $5.50. x + 429 pp.; ill. 1947.

This book represents a critical review of past conceptions of fatigue and impairment as well as a fairly exhaustive survey of the results contained in the literature of experimental research. The fundamental viewpoint taken by the authors is that fatigue is an experience of general body discomfort that results from conflict, biochemical, neuromuscular, or psychological. Impairment is used specifically to refer to specific tissue conditions. Bartley and Chute point out that fatigue is not necessarily the direct result of energy expenditure, nor is it synonymous with boredom or with physiological impairment. Furthermore, neither fatigue nor impairment can be measured by work decrement. They stress the point that fatigue must be considered a subjective phenomenon which is largely the result of the individual's past learning, personal values and needs, and basic organization.

With this frame of reference established in the first three chapters, the authors maintain a clear separation of the concepts of fatigue and impairment in their review of the literature. First they consider the electrophysiological studies of the neuromuscular system aimed at the measurement of impairment. Then they take up the following factors in the last sixteen of their twenty chapters: lack of sugar in the body; temperature and water and salt lack; metabolism and nutrition; visual-fatigue studies; hours and conditions of work in industry; drug action; organization in neuromuscular activity; sleep and other periodicities; long-term changes in the individual; mental fatigue; personal factors; visual performance; conflict and frustration; and chronic fatigue and related syndromes.

In the concluding chapter of this excellent book, the authors point out that we must know more about the person as a whole if we are to know more about fatigue. We must find out what kinds of individuals are prone to fatigue and under just what conditions of personal organization and environmental circumstance. A clearly defined, logical, and experimental approach to the problem is outlined in the final paragraphs.

ELIOT STELLAR

GENERAL ENDOCRINOLOGY.

By C. Donnell Turner. W. B. Saunders Company, Philadelphia and London. $6.75. xii + 604 pp.; ill. 1948.

Turner has written a volume which touches on many aspects of endocrinology. He stresses particularly what may be called experimental endocrinology in the mammal. The facts and ideas of clinical endocrinology are subordinated. The text includes, on the other hand, chapters on the features of endocrinology in insects, a discussion of the nature of chemical coordinators (organizers) in embryonic development, and a description of the actions of plant hormones. The viewpoint which Turner essays, therefore, is one intended to give the college reader a broad picture of the "coordinating" mechanisms, of a chemical nature,

in plant and animal life generally. To a large degree he has been successful. Surely there is no other book which presents quite so clearly and simply the broad range of action of the hormones concerned in body functions in mammals.

The success with which Turner has achieved his primary objective, that of portraying the role of hormones in biological processes in general, is less than that of his treatment of descriptive mammalian endocrinology. In the first place, the subject of endocrinology is not yet ready for broad generalizations. Generalization will ultimately be achieved, on the level of the basic cytochemical mechanisms whereby hormones accelerate, inhibit, or otherwise modify energy exchanges and growth processes within various types of plant and animal cells. Such a viewpoint is lacking in this book. This is no fault of Turner's, however, since the status of endocrinology today does not permit broad interpretations along these lines.

S. R. M. REYNOLDS

ADOLESCENT STERILITY. *A Study in the Comparative Physiology of the Infecundity of the Adolescent Organism in Mammals and Man.*

By M. F. Ashley Montagu. Charles C. Thomas, Springfield, Illinois. $3.50. x + 148 pp. 1946.

If the author of this little book overlooked any reference to his subject it is not detectable by the average reader. In fact, the reviewer was more impressed by the number of references cited than by the publisher's claim—for which the author is not to blame—that the book contains "new information of major importance on adolescent sterility." The references are drawn from many fields and many countries, reflecting great industry and versatility on the part of the author. Possibly because of their number, or because some of the material was published elsewhere, one feels as though the bibliography has gone beyond the material presented and that the book resulted from a bibliography looking for parking space. For instance, one footnote runs to 39 lines and cites 19 references; and another runs to 89 lines and cites 56 references. Two sentences later there is another footnote. This does not detract from the text, which is interestingly written; and most points are well argued. The weakest part of the book deals with the hormonal aspects of adolescent sterility. It seems unwise, for instance, to say that "first or early menstruations must be unassociated with ovulation." The use of the older spelling for estrus and estrogens and of ICSH for LH is a bit awkward. This is a stimulating little book intended more for the physician than for the professional biologist.

ROBERT K. ENDERS

LES ANTIBIOTIQUES. *Trois Conférences. Médicine et Biologie, Number 4.*

By Selman A. Waksman. Editions Desoer, Liège; Masson & Cie., Paris. 80 fr. (paper). 107 pp.; ill. 1947.

This small booklet is a translation into French of the text of three lectures delivered by Selman A. Waksman at the University of Liége in October 1946. The first chapter is concerned with the nature and production of antibiotics. The second chapter is devoted to a discussion of the activity and therapeutic uses of the antibiotic agents. A third chapter is concerned with the isolation, toxicity and chemotherapeutic uses of streptomycin. This volume offers very little of interest to readers in this country at this date.

C. JELLEFF CARR

A LABORATORY MANUAL OF EXPERIMENTAL PHARMACOLOGY *for Veterinary Students. Second Edition.*

By Bernard V. Alfredson. Burgess Publishing Company, Minneapolis. $2.75 (paper). iii + 156 pp.; ill. 1947.

The arrangement of the laboratory experiments in this manual conforms to a general outline based upon the pharmacology of particular organs or systems. Each exercise considers a number of different animals, and variations in species have been stressed. The text is illustrated with a number of excellent drawings that demonstrate the various techniques employed in injecting drugs and withdrawing blood, and certain of the more involved laboratory experiments on animals. Those interested in teaching laboratory courses in biochemistry, physiology, and pharmacology will find many suggestions in this manual.

C. JELLEFF CARR

THE CHEMOTHERAPY OF FILARIASIS. *Annals of The New York Academy of Sciences, Volume 50, Article 2, May 25, 1948.*

By L. L. Ashburn, F. C. Bartter, Raymond N. Bieter, F. J. Brady, L. M. Brancone, Theresa Brey, L. G. S. Brooker, H. W. Brown, Ernest Bueding, T. A. Burch, Mary C. Clark, L. T. Coggeshall, D. B. Cowie, Ashton C. Cuckler, James T. Culbertson, R. W. Cunningham, Elizabeth M. Cranston, J. J. Denton, Sybella Halliday, B. K. Harned, R. I. Hewitt, S. Kushner, John T. Litchfield, Jr., W. L. McEwen, T. H. Maren, J. Oliver-Gonzalez, G. F. Otto, Lawrence Peters, Harry M. Rose, D. Santiago-Stevenson, H. W. Stewart, Y. SubbaRow, R. J. Turner, R. E. Vessey, W. S. Wallace, D. E. White, Harold N. Wright, and N. N. Yuda. The New York Academy of Sciences, New York. $2.50 (paper). Pp. 19–170; ill. 1948.

There are 15 papers in this series presented at a Conference on the Chemotherapy of Filariasis held by the Section on Biology of the New York Academy of Sciences on October 17 and 18, 1947. A review of the disease is presented by L. T. Coggeshall in the first chapter, and the general experimental methods used in studying filaricides are described by R. I. Hewett in the second chapter. The remaining sections are devoted to reviews of the recent experimental work carried out by a number of research groups. The discussions included the following drugs: the arsenicals, Anthiomoline, Neostibosan, the antimonials, the cyanine dyes, and the piperazine compounds. This volume presents the most up-to-date review of the chemotherapy of filariasis available at the present time.

C. JELLEFF CARR

APPROACHES TO TUMOR CHEMOTHERAPY. *A symposium of papers and discussions on various aspects of tumor chemotherapy, developed from the summer meetings of the Section on Chemistry (C) of the American Association for the Advancement of Science at Gibson Island, Maryland, 1945–1946.*

Edited by Forest Ray Moulton. American Association for the Advancement of Science, Washington, D. C. $7.50; $6.50 (A.A.A.S. members). x + 442 pp.; ill. 1947.

This volume is a collection of papers and revised discussions presented at the 1945 and 1946 A.A.A.S. Gibson Island Research Conferences, along with various other invited papers designed to present a comprehensive view of the field of tumor chemotherapy. A previous volume covered the papers and discussions of a more general A.A.A.S. Gibson Island Research Conference on cancer which was held in 1944 and published in 1945. In all of these conferences, emphasis was placed on free and unlimited presentation and discussion. While many of the contributions to the discussion have undergone extensive post-conference correction, amplification, or deletion by their respective authors, most of the clashes of opinion and argument that arise from such discussions have been retained and constitute an important feature of the book.

The initial and introductory chapter was written by William H. Woglom, who has a more extensive background in this field than any other participant. His general review of cancer chemotherapy is not optimistic but extremely illuminating. The reviewer heard Doctor Woglom's paper, and recalls especially one sentence that imprinted itself indelibly on everyone's mind. The problem of the therapy of cancer, he said, "is almost—not quite, but almost—as hard as finding some agent that will dissolve away the left ear, say, yet leave the right ear unharmed; so slight is the difference between the cancer cell and its normal ancestor." He then went on to describe and classify the great number of things that have been tried in order to discover an effective therapeutic agent.

The rest of the book is divided into sections on special methodology, nutritional factors, bacterial products, nitrogen mustards, and one section on the application of miscellaneous agents clinically. Of special interest in the first section was the adaptation of the transparent chamber technique as a tool in the study of experimental tumor therapy by Glenn H. Algire. The section on nutritional factors includes the work of Tannenbaum on the effect of caloric restriction, and the work of Lewisohn and his group on the therapy of mouse cancers with folic acid. This part of the book is a good introduction to the later extensive work on folic acid and its derivatives. The review of the work with bacterial products, such as the Coley bacterial toxins, and the extensive work with bacterial polysaccharides constitute the numerous contributions in the section on bacterial products. The section on nitrogen mustard contained mostly invited papers designed to round out the subject. This includes much of the basic preliminary work in this field, which was done just previous to the appearance of the symposium. The miscellaneous items in the last section include a chapter by Huggins on some of the early attempts to utilize estrogens to control prostatic carcinogenesis. Haddow's early work on the use of urethane in leukemia is another notable contribution to this section.

This volume thus represents a well rounded—even if incomplete—picture of the representative views in the field of tumor chemotherapy as they existed at the time of these conferences. Since its appearance, some of the optimism expressed for certain agents being investigated at that time has gradually disappeared and has already been replaced by new hope based on other agents. One cannot witness the kaleidoscopic appearance and disappearance of chemotherapeutic agents for cancer very long without adopting a slightly pessimistic view like that expressed in the introduction by Woglom. It is fitting to close this review of the book with his last sentence, "If the cancer cell is as some insist, a sick cell, it seems curious that it should resist so successfully all attempts to administer the coup de grâce."

FRANK H. J. FIGGE

ANIMAL NUTRITION

SELECTED WORKS OF HENRY CLAPP SHERMAN.

The Macmillan Company, New York. $5.00. xlviii + 1056 pp. 1948.

In the growth of the science of nutrition in the United States, few are entitled to stand beside the man a selection of whose works has been collected here. It is definitely a selection, even though no fewer than 119

papers are included, for Sherman's monumental bibliography reveals a production, through 1947, of 320 papers (of which over 200 report original research) and 11 books. The contributions here reprinted are reproduced by the offset process, so that type and format are not uniform throughout the volume; but the type and illustrations, except for a few half-tones, are clear and legible. In addition to the 119 papers on enzymes, vitamins, mineral nutrients, and a great variety of other topics in the field, the volume includes a 9-page introduction by Sherman himself, an anonymous appreciation by his students and coworkers, a biographical sketch, and the chronological list of his publications. No man, toward the end of a long and fruitful career, could desire a more fitting memorial. That it has come while he can still appreciate it is particularly gratifying.

BENTLEY GLASS

NUTRITION IN HEALTH AND DISEASE. *Tenth Edition. By Lenna F. Cooper, Edith M. Barber and Helen S. Mitchell. J. B. Lippincott Company, Philadelphia, London, and Montreal.* $4.00. xviii + 729 pp. + 4 plates; text ill. 1947.

The ninth edition of this standard textbook for nurses and dietitians was reviewed in 1944 (QRB 19: 252). It has not been fundamentally changed in the tenth edition, but the format has been altered to the double-column page, and the seven parts of the earlier organization have been regrouped into four: Principles of Nutrition; Diet in Disease; Food Selection and Preparation; Tabular Material and Special Tests. The result is a suitable reference for the home as well as a good textbook.

PRINCIPLES OF FEEDING FARM ANIMALS. *Revised Edition.*

By Sleeter Bull and W. E. Carroll. The Interstate, Danville, Illinois. $2.75. xii + 395 pp.; ill. 1946.

This book is based on a volume written by Bull for the use of beginning students in animal husbandry. The first six chapters deal in an elementary way with the underlying principles of animal nutrition. Chapters are arranged according to each of the chief feeds, rather than by the different classes of animals. Thus, under a given feed, one will find its use in the different rations required for growing or fattening various animals, as well as for compounding rations for breeding, dairy, and work animals. A chapter is also included on the fertilizing value of different feeds and rations. The book is indexed and well illustrated and should be of value to the farmer who is without technical education and for those who contemplate raising livestock but have had little or no experience in feeding them.

DAVID B. TYLER

THE FEEDING OF FARM LIVESTOCK. *Agricultural and Horticultural Series. Second Edition.*

By J. C. B. Ellis. Crosby Lockwood & Son, London. 18s. xvi + 271 pp. + 12 plates. 1947.

This textbook is designed primarily for the British student and farmer, and deals with feeding problems of livestock with the feeding stuff available in pre-war England. Its object is to explain how rations may be computed by using the starch equivalent of Kellner and the protein equivalent as standards of energy and protein. The author, looking forward to a time when increased supplies will be available to the British farmer, wisely avoids stressing makeshift or temporary methods of rationing. The various feeds have been grouped according to type, so that comparisons may be drawn between the different types as well as between members of the same type, the basis of comparison being the ratio: starch equivalent/protein equivalent. This system of rationing can be satisfactorily applied to cattle and pigs, as a large body of data has been accumulated regarding the nutritive requirements of these animals. However, it is unsatisfactory with horses, sheep, and poultry, for a variety of reasons discussed by the author. The feeding of each of these livestock is discussed in separate chapters.

This is a well written text. Despite the fact that it is designed primarily to meet British problems, it should be of interest to many students and farmers in the United States who are concerned about more economical means for fattening cattle. It is well indexed and illustrated. References are given in footnotes.

DAVID B. TYLER

BIOCHEMISTRY

ANNUAL REVIEW OF BIOCHEMISTRY. *Volume XVII. Edited by J. Murray Luck, Hubert S. Loring, and Gordon Mackinney. Annual Reviews, Stanford, California.* $6.00. x + 801 pp. 1948.

This is the 17th volume of the *Annual Reviews of Biochemistry*. The editors, reviewers, and readers alike are convinced that this seventeen-year experiment has been an outstanding success. The contemplated extension of the *Annual Reviews* to the fields of psychology, physical chemistry, and medicine will be eagerly awaited and may help to relieve an increasingly desperate need. In the preface it is stated that: "The second edition of the *World List*, published in 1934, listed 36,000 scientific periodicals. Fifteen thousand of these were classified by Bradford as useful;

the remainder as containing papers of less importance. The 15,000 were published in 1934 at the rate of 750,000 good or fair papers per year. According to E. W. Hulme the yearly average of papers in the pure sciences was close to 3,100 for the period 1800–1863, rising to about 22,600 for the period 1874–1900 and to 85,500 in 1910. The implications of these data are sobering, not only because of the perplexities that now confront the reader, the publisher, and the librarian, but because of the exponential nature of the growth of scientific literature: future generations will find themselves buried in paper and entombed in libraries unless paper pulp reserves run out or some sensible solution to the problem is found."

The editors and editorial committee of the *Annual Reviews* have attempted to stimulate critical reviews that screen the literature rather than to make synopses of all contributions. In this effort they have achieved a considerable degree of success, but even so the last few *Annual Reviews of Biochemistry* have been volumes of approximately 800 pages. This is related to the growth of scientific literature rather than to an uncritical appraisal or attitude on the part of most of the reviewers. In order to keep the size of the *Review* within reasonable limits in the future, it is planned to transfer some of the chapters on plant physiology and plant nutrition to a new *Annual Review of Plant Physiology*, which will make its appearance in 1950.

As stated in the review of volume 16 of this series, it would be presumptuous of a reviewer to be critical of most of the reviews and futile to attempt to summarize all of the chapters and subjects covered. This year's volume contains 27 reviews which average 28 pages each. The author index lists approximately 4500 names, and the 19 pages of the subject index mentions over 2200 items.

As in previous years, there are chapters on biological oxidations and reductions, non-oxidative enzymes, the chemistry of proteins and amino acids, the chemistry of carbohydrates, carbohydrate metabolism, lipid metabolism, and the biochemistry of hormones and vitamins. By changing the authors of these chapters each year the subject matter may be entirely different, or at least emphasis and viewpoint vary from year to year. There appears to be no more practical way for biologists to keep abreast of the biochemical advances in their own and related fields than to read the chapters that attract their interest in these yearly volumes.

In using these reviews it is well to keep in mind that one cannot predict from the title of the chapter headings what is the content of the review. For example, the chapter on Metabolism of Drugs and Toxic Substances, by O. Bodansky, discusses among other subjects the metabolism of carcinogenic hydrocarbons, pressor amines, phenols, sulfonamides, steroids, xanthines, and carcinogenic azo dyes. The chapter on the Biochemistry of the Natural Pigments is limited to pyrrole pigments and in this respect resembles Holdenre's view of this same subject a few years ago. The excellent chapter on the Biochemistry of Carcinogenesis, by Rusch and LePage, is limited but discerning. The organization and treatment of the material indicates a profound knowledge and a considerable background in the study of this process. Finally there is included a chapter on the Physiological Aspects of Genetics, by Beadle. This had been published previously in the *Annual Review of Physiology* but was considered so excellent that it was reprinted in this volume.

FRANK H. J. FIGGE

INTRODUCTION TO CARBOHYDRATE BIOCHEMISTRY. *Second Edition.*

By D. J. Bell; with a Foreword by F. G. Hopkins. University Tutorial Press, London. 6s. viii + 108 pp. 1948.

One would like to see more small books of this type. They are particularly desirable, since they can be more frequently and thoroughly revised than a larger, more general text. Furthermore, if prepared by those of wide experience in their specialty, there is a better chance that the subject will be treated authoritatively. Few of the larger general textbooks can be considered authoritative on every subject covered.

D. J. Bell's book treats in a concise way eight subjects in the biochemistry of carbohydrates: Small Molecules: Sugars; Large Molecules: Polysaccharides; Oxygen Glycosides; Uronic Acids; Nitrogen Glycosides, Nucleotides, and Nucleic Acids; Intracellular Mechanisms of Synthesis and Breakdown of Carbohydrates: Phosphorolysis; The Biological Liberation of Energy from Carbohydrates: 1. Alcoholic Fermentation; and The Biological Liberation of Energy from Carbohydrates: 2. Muscle Glycolysis.

The references at the end of each chapter are not numerous but they have obviously been selected to include many fundamental and original papers and should be of use even to the more advanced students of biochemistry and biology. This sound little text is unhesitatingly recommended for students, teachers, and research workers in biology and chemistry.

DAVID B. TYLER

THE CHEMICAL CONSTITUTION OF NATURAL FATS. *Second Edition Revised.*

By T. P. Hilditch. John Wiley & Sons, New York. $9.00. xiv + 554 pp.; ill. 1947.

The first edition of this valuable book appeared in 1939. The titles of the eleven chapters describe well the character of the book: Introductory Survey of the Natural Fats; The Component Acids of Fats of Aquatic Flora and Fauna; The Component Acids of Fats of

Land Animals; The Component Acids of Vegetable Fats; The Component Glycerides of Natural Fats; The Component Glycerides of Vegetable Fats; The Component Glycerides of Animal Fats; Some Aspects of the Biochemistry of Fats; Constitution of Individual Natural Fatty Acids; Synthetic Glycerides: Individual Naturally Occurring Fatty Alcohols and Acyl Ethers of Glycerol; and Notes on Experimental Techniques Employed in the Quantitative Investigations of Fats. These are followed by a general index, and separate indexes of individual fats and waxes, plant families, individual fatty acids, and individual glycerides.

Much new material has been incorporated in the book, but without deletion of a considerable number of obsolete statements. An example is the statement, which occurs several times, that isovaleric acid is the only acid containing a branch chain or an odd number of carbon atoms which occurs in nature. Other more recently discovered acids of this type are included without a correction of the older misstatement. The investigator will find it necessary to consult scientific journals to supplement the information which the author gives concerning technical methods of research on fats and their derivatives. These are minor weaknesses in a volume which is the best of its kind, and which is a treasure house of information of interest to biochemists and biologists.

E. V. McCollum

Advances in Enzymology *and Related Subjects of Biochemistry. Volume VIII.*

Edited by F. F. Nord. Interscience Publishers, New York and London. $8.00. xii + 538 pp. 1948.

Biologists will find in this volume much information of interest and value. Not a few of the topics considered cover fields which are seldom adequately reviewed. The editor is to be congratulated on the range of subjects and essayists. As in some previous volumes of this series, a number of excellent contributions by our European colleagues are presented.

The first chapter, by Ludwik Monne, is entitled Functioning of the Cytoplasm. Emphasis is placed here on the exhibition, wherever possible of "regular, microscopic, and submicroscopic structural changes underlying any function of the cytoplasm. The effort and purpose of the author was certainly a noble one, and if it has failed in certain respects to attain the goal set, it did so because the available information is not sufficient for the task. It does not seem likely that very fruitful correlations between structure and function at the protoplasmic level can be attained until the intracellular geometry of the units of function (enzymes) is finally mapped out.

Under the rather prosaic title, Quantitative Studies on Complement, Heidelberger and Manfred have summarized some rather remarkable recent advances in our knowledge of that mysterious cofactor of the immunologic reactions called "complement." A major share of these advances has been due primarily to the efforts of Heidelberger and his associates. The development of methods permitting a quantitative estimation of the amount of complement combined during antigen-antibody reactions is described. Once again Heidelberger's ingenious applications of the rigid criteria of analytic chemistry have yielded results of prime importance in immunochemistry.

J. P. Greenstein gives another example of his thorough scholarship in his review of Dihydropeptidases, a field in which he and his associates have themselves made many of the significant advances. The usual peptidases catalyze the hydrolytic cleavage of normal saturated alpha-amino acids. The dihydropeptidases are concerned with the cleavage of peptides containing an alpha-beta double bond and a substituted amide bond on the alpha-carbon. The probable importance of these peptides in the nitrogen metabolism of cells is highly emphasized by two characteristics. One is the possession of a highly reactive acylated nitrogen, and the other is their obvious relationship to the alpha-keto acids to which they give rise upon hydrolysis.

R. F. Dawson's discussion of Alkaloid Biogenesis is noteworthy both for its clarity and for the helpful explicitness of the criteria he has employed to evaluate the available information on this subject. The laboratory of F. F. Nord has in recent years been actively investigating the biochemistry and biology of wood decay. The work of this group, as well as others, is ably summarized by Nord and Vitucci. One of the knottier questions considered is the constitution and mechanism of formation of lignin. A rather surprising feature to emerge is that experimental support can be furnished for the suggestion that an enzymatically formed methylated aromatic compound can serve as a transition between carbohydrate degradation and lignification.

Other topics discussed include the antifatty liver factor, by Chaikoff and Entenman; lipid synthesis, by Kleinzeller; the auto-oxidation of unsaturated fatty acids, by Holman; and an extraordinarily stimulating discussion of the biochemistry of fatty acid catabolism, by F. L. Breusch. The volume concludes with an absorbing chapter on snake venoms, by E. A. Zeller. These substances have been found to contain quite an area of highly active enzymes which include phosphotases, esterases, amino acid-oxidases, etc. Of particular interest to the general biologic reader are the discussion of the phylogenetic significance of the enzyme pattern and a comparison of the conclusions drawn from this evidence with those derived from comparative anatomy and physiology.

S. Spiegelman

CHROMATOGRAPHY. *Annals of the New York Academy of Sciences, Volume XLIX, Article 2.*

By Harold G. Cassidy, Norman Applezweig, Stig Claesson, Victor R. Deitz, Beveridge J. Mair, A. J. P. Martin, Stanford Moore, Robert L. Peck, W. A. Schroeder, Leo Shedlovsky, William H. Stein, Henry C. Thomas, and L. Zechmeister. New York Academy of Sciences, New York. $2.75 (paper). Pp. 141–326; ill. 1948.

The increasing importance of chromatography as an analytical tool and the diversity of its application to problems in chemistry and biology are well illustrated by the excellent series of papers contained in this monograph. Especially timely are the discussions of such rapidly developing fields as partition chromatography (A. J. P. Martin; S. Moore and W. H. Stein), frontal analysis (S. Claesson), and ion-exchange adsorption (N. Applezweig). Biologists will no doubt be interested in L. Zechmeister's brief historical sketch of Michael Tswett, the Russian botanist and inventor of chromatography.

FRANCIS HAXO

A SYMPOSIUM ON THE USE OF ISOTOPES IN BIOLOGY AND MEDICINE.

Contributed by Hans T. Clarke, Harold C. Urey, Glenn T. Seaborg, Paul C. Aebersold, Alfred O. Nier, Charles D. Coryell, Martin D. Kamen, Donald B. Melville, David B. Sprinson, Harland G. Wood, Konrad Bloch, David M. Greenberg, I. L. Chaikoff, Joseph G. Hamilton, Byron E. Hall, Saul Hertz, William F. Bale, James J. Nickson, and Farrington Daniels. The University of Wisconsin Press, Madison. $5.00. xiv + 445 pp. + 11 plates; text ill. 1948.

This volume is even broader in the field encompassed by it than is indicated by its title. The separation of stable isotopes and international aspects of atomic energy are discussed by H. C. Urey; the preparation of radioactive isotopes, by G. T. Seaborg; the detection of stable isotopes, by A. O. Nier; the availability of isotopes, by P. S. Aebersold; fundamental principles of the detection and measurement of radioactivity, by C. D. Coryell; and the development of atomic energy, by F. Daniels. Perhaps more closely related to the immediate interests of most biologists and physicians are the following: the historical background of isotopes in biochemistry (H. T. Clarke); assay of radioactive isotopes in biological research (M. T. Kamen); preparation of compounds containing isotopes (D. B. Melville); studies in the metabolism of proteins (D. B. Sprinson); use of isotopes in the study of intermediary carbohydrate metabolism (H. G. Wood); intermediary metabolism of lipids (K. Block); studies in the metabolism of mineral elements with radioactive isotopes (D. M. Greenberg); application of radioactive iodine to studies in iodine metabolism and thyroid function (I. L. Chaikoff and A. Taurog); medical applications of radioactive tracers (J. G. Hamilton); therapeutic use of radiophosphorus (B. E. Hall); treatment of thyroid disease with radioactive iodine (S. Hertz); health hazards in the use of radioactive isotopes (W. F. Bale); and measures for the protection of property and personnel (J. J. Nickson). It is fortunate that we have now available the experiences and views of so many authorities in this live and rapidly growing field.

L. B. FLEXNER

RADIOACTIVE INDICATORS. *Their Application in Biochemistry, Animal Physiology, and Pathology.*

By George Hevesy. Interscience Publishers, New York and London. $10.00. xviii + 556 pp. + 1 chart; text ill. 1948.

Hevesy's volume on radioactive indicators has been awaited with keen anticipation since its first announcement. As the pioneer in the use of these substances in biology, one whose fundamental investigations were rewarded by the Nobel Prize in 1943, he has been in a singular position to appreciate and evaluate this rapidly growing field.

The book is extraordinarily comprehensive and complete. There are 12 chapters devoted to discussions of the production of radioactive indicators; radioactive isotopes of possible interest in tracer work; the determination of radioactivity; atomic interchange; the application of isotopic indicators in chemical analysis; the absorption, distribution, and excretion of elements; the application of isotopic indicators in the study of the permeability of phase boundaries (permeability of biological membranes); turnover studies; the paths of intermediary reactions; skeleton metabolism; the application of radioactive indicators in the study of red corpuscles; and the shortcomings of radioactive indicators. In those parts of this large field where the reviewer's knowledge permits him to be critical, it is clear that the author orients the reader to the problems of the subject and then presents experimental findings with accuracy and in well chosen detail and draws upon a bibliography of remarkable scope.

Hevesy's important book is enthusiastically recommended to all investigators, actual and potential, in the field of radiobiology and to all those who desire an authoritative knowledge of the subject. It is a distinguished contribution.

L. B. FLEXNER

BIBLIOGRAPHY OF THE LITERATURE ON THE MINOR ELEMENTS AND THEIR RELATION TO PLANT AND ANIMAL NUTRITION. *Volume I. Fourth Edition.*

Compiled and Published by the Chilean Nitrate Educational Bureau, New York. iv + 1037 pp. 1948. This enormous volume contains approximately 10,000 abstracts, including all the material in the third edition and the seven supplements published since it appeared, in February, 1939. The pages have been reproduced by offset lithography, but legibility is in general good. The abstracts are not original, but have been taken from *Chemical Abstracts*, the *Experiment Station Record* (U. S. Dept. Agri.), *Soils and Fertilizers* (Imp. Bur. Soil Sci., G. B.), and other journals. Selection and classification have not always been performed by experienced personnel, as is evident from the inclusion of a paper on the luciferin-luciferase system under Iodine on the basis of a reference to "coenzyme I". Such errors are few, of course, and do not alter the indispensability of the reference work for all those who have to do with the minor elements in nutrition and physiology.

W. D. McElroy

Exposés Annuels de Biochimie Médicale *Publiés sous la Direction de Michel Polonovski. Sivième Série.*

By P. Boulanger, R.-G. Busnel, R. Courrier, G. Florence, Cl. Fromageot, M. Polonovski, J. Roche, J. Roskam, and Ch. Sannié. Masson et Cie., Paris. 580 fr. (paper). 301 pp. + 2 colored plates; ill. 1946.

Contents: Functional correlations between steroid substances (R. Courrier); Spectography in biology* (G. Florence); Mean "bleeding time" and the metabolism of the chemical mediator of adrenergic excitation (J. Roskam); Enzymes with a dissociable metallic constituent, and the interchangeability of active metals (J. Roche); Sodium and potassium in the animal organism* (P. Boulanger); Biochemistry of pterines (M. Polonovski and R.-G. Busnel); Pigments and antibiotic substances of fungi and bacteria*; (Ch. Sannié); Some aspects of sulphur metabolism in higher animals (Cl. Fromageot). The titles starred have extensive bibliographies. The articles on pterines, fungal pigments, and spectrography may be particularly recommended for their topicality and information.

H. R. Catchpole

MICROBIOLOGY

A Text-book of Bacteriology. *Fifth Edition. By R. W. Fairbrother. Grune & Stratton, New York.* $6.00. viii + 480 pp. + 6 plates; text ill. 1948. This textbook is designed for medical students. The present edition was published in England in September, 1946, but not reprinted in the U. S. A. until January, 1948. The book is divided into three parts: General Bacteriology; Systematic Bacteriology; and General Technique. Included in the first section is a short chapter on Chemotherapy, dealing primarily with the sulfonamides and penicillin, the more recent antibiotics being only mentioned. The majority of the book is on Systematic Bacteriology. This includes short descriptions of the bacteria usually associated with disease and the infections they may produce. There are short chapters on the Filtrable Viruses, Rickettsiae, and Bacteriophage, and one on the Bacteriology of Water, Milk and Shellfish.

The final section on techniques contains the formulas and procedures for the commonly used bacteriological stains, a section on media, and one on serological techniques. The section on media could be better. Meat infusion medias are still given priority over media with the newer bacteriological peptones. There is a good index.

As a textbook for medical students this book is probably adequate. It acquaints them with the common laboratory procedures which are available as an aid to diagnosis. Of necessity only the very pertinent material is given, and this very concisely.

E. Petran

Bacteriology *Laboratory Directions for Pharmacy Students. Second Edition.*

Compiled by Milan Novak and Esther Meyer. The C. V. Mosby Company, St. Louis. $2.75 (paper). 248 pp.; ill. 1947.

This is a detailed outline of the laboratory course in Bacteriology given at the College of Pharmacy of the University of Illinois in Chicago. The laboratory exercises are systematically and clearly presented in day-by-day form. The subject matter is more inclusive than is usually found in a course of this type and on the whole is up to date. A couple of the notable exceptions to this are the continued use of Endo's and E. M. B. media for the isolation of intestinal pathogens and the omission of the use of a tellurite medium in the culturing of *C. diphtheriae*. Most teachers of laboratory science prefer to arrange their own laboratory outlines. However, this one could be very helpful in arranging a course.

E. Petran

HEALTH AND DISEASE

Medicine in the Changing Order.

Report of The New York Academy of Medicine Committee on Medicine and the Changing Order. The Commonwealth Fund, New York; Geoffrey Cumberlege, Oxford University Press, London. $2.00. xx + 240 pp. 1947.

The growing problem of providing adequate distribution of medical care and facilities to all the people of the United States is attracting the serious attention not only of the medical profession, but of the public as well. In order to bring some light to bear on the problem, The New York Academy of Medicine formed a Committee on Medicine and the Changing Order to study the matter and make a report of their findings. The present volume encompasses the gist of the Committee's deliberations.

Cognizance is taken of the fact that the better distribution of medical care is an extremely complex problem, not to be solved by one swift stroke of genius or legislation, but rather, one that has to be solved in terms of local needs, and one that will require considerable time, thought, effort, and money. As a result of their study, the Committee recommends some sort of prepayment medical insurance, and is strong in its opposition to any form of compulsory health insurance as a step toward better distribution of medical care. In addition to the extension of voluntary non-profit medical insurance, the Committee recommends federal, state, and municipal subsidies to the completely indigent and medically indigent for the payment of premiums on such medical insurance, in an effort to improve the quantity and quality of medical care in urban areas. For the improvement of rural health, the Committee recommends an expansion of federal, state, and local public health services and facilities in the fields of sanitation, immunization, and health education. It also recommends that such services and facilities, on both the national and state levels, be coordinated under one department, to meet the inadequacies inherent in the present system where they are scattered through many agencies.

To provide a better quality of medical care, the Committee recommends the reorganization of medical education, to shift the emphasis from the recognition and treatment of acute illnesses to chronic diseases and preventive medicine. Group practice, with its resultant reduction in overhead expense, is suggested as a possible means of providing adequate medical care at rates consistent with present economic conditions. Included in the volume are also enlightening discussions of the role of the dentist, the nurse, and the hospital in the distribution of medical care. There is a subject index.

B. AUBREY SCHNEIDER

ENCYCLOPEDIA OF MEDICAL SOURCES.

By Emerson Crosby Kelly. The Williams & Wilkins Company, Baltimore. $7.50. vi + 476 pp. 1948.

To all those lost in the eponymical jungles of medicine and neighbor sciences like anatomy, embryology, physiology, biochemistry, bacteriology, pharmacology, or the like, E. C. Kelly of Albany, to whom we owe already the spendid Medical Classics Series, has rendered a tremendous service. One day he realized that though almost everybody talks of, let us say, Macmonkey's method, nobody knows exactly what it means or what Macmonkey meant nor where it can be found in the literature. So he sat down and collected, under the names of more than 8000 authors, from Aagren to Zwemer, the respective methods, gadgets, theories, parts, operations, etc., connected with their names, together with the exact references to the literature. To the names are added short characteristics like "Cleveland biochemist," or "Philadelphia pathologist," and the life data. This breathtaking enterprise is completed by a subject index. Of course, further editions of this absolutely indispensable reference work will add what one or another reader will miss. The remarkable thing about this book is not that at present one may find one or another gap, but that one man should be able to cover the field so completely at a first attempt.

ERWIN H. ACKERKNECHT

NUTRITION IN PUBLIC HEALTH.

By Lucy H. Gillett. W. B. Saunders Company, Philadelphia and London. $2.75. xii + 303 pp.; ill. 1946.

This excellent textbook has been designed primarily for the public health nurse, to assist her in the dissemination of information on nutrition in her daily work with the family, the school, and the community. It may well be used as a guide in a course of study for any group especially interested in any of the problems relating to foods, diet, or general nutrition applied to health and disease.

The author has presented an abundance of well integrated and illustrated material regarding not only the general aspects of nutrition in health, as depicted in the daily body requirements for the various food elements and vitamins, but to such specific problems as the variations of nutritional requirements at various ages, diets suited for those with special medical or health conditions, and the economic aspects of nutrition relating to the procurement and preparation of various foods. The chapter on the food customs of various racial and national groups will be particularly enlightening to the public health nurse, since it will give her much of the necessary background information for dealing with the nutritional problems of these groups.

The value of the work is further enhanced by the inclusion of a wealth of tabular and graphic material, as well as a number of suggested diets for practical use in the maintenace of sound health. The detailed index adds considerably to the value of the volume as a home or office reference book on foods and nutrition.

B. AUBREY SCHNEIDER

AN INTRODUCTION TO PERSONAL HYGIENE.

By Laurence B. Chenoweth. F. S. Crofts & Company New York. $2.50. xx + 345 pp.; text ill. 1947.

The increasing amount of attention given to the field of health education at the secondary school level, with the resulting broader health background of students entering college, has created a need for a college textbook on health and hygiene of a more advanced nature than those generally in use at the present time. This carefully organized and well written book is the author's attempt to fulfill this need. It is intended for a one-semester college course in personal hygiene. A textbook on *Community Hygiene*, by Chenoweth and Morrison, can be used to supplement it for a second semester course.

The historical approach is used in presenting the subject matter, each topic being introduced and discussed from the chronological point of view. Considerable effort has been made to point up the physiological aspects of the body in health and disease. Special emphasis is placed on such pertinent health problems as nutrition, human reproduction, heredity, tuberculosis, syphilis, cancer, mental hygiene, and alcohol. The work is well documented and carefully illustrated. A glossary and an index are included.

B. AUBREY SCHNEIDER

LA MALADIE D'EHLERS-DANLOS. *Etude Clinique Anatomo-Pathologique et Génétique. Université de Nancy, Faculté de Médecine, Number 30.*

By Odile, Marie, Gabrielle, Fabiola Lienhart. Société d'Impressions Typographiques, Nancy; O. Lienhart, 61 Rue Isabey, Nancy. Free upon request (paper). 116 pp. + 2 plates + 1 chart. 1945.

Ehlers-Danlos disease is a rare condition characterized by hyperelasticity of the skin and ligaments and a marked susceptibility of the skin to trauma, with resultant disfiguring scars. Many of the "India rubber men" of sideshows have this disease. The author bases this, her M.D. thesis, on a detailed description of a single affected individual, together with an extensive review of the literature, with emphasis on French publications. Complete autopsy findings are presented for the first time. An anomalous distribution of elastic tissue fibers was noted, with a relative increase in the dermis but a decrease in the lungs and aorta. From a review of the literature it is concluded that the condition is due to a dominant gene, the degree of expression of which is strongly conditioned by various modifiers. No family history was available in the author's case because the patient was a mentally retarded orphan.

JAMES V. NEEL

DENTAL CARIES: *Its Etiology, Pathology, Clinical Aspects and Prophylaxis.*

By Bernhard Gottlieb. Lea & Febiger, Philadelphia. $10.00. 262 pp. + 7 plates; text ill. 1947.

The ten chapter titles are: Development and structure of enamel; Acid action on enamel; Enamel caries; Acid action on dentin; Dentin caries; Cementum caries; Secondary dentin and related problems; Abrasion; Caries prophylaxis by impregnation of the invasion roads; Fluorine and teeth. The author mentions a great many items which fall within the scope of the chapter headings, but in no instance does he give a clear and logical discussion of any. To cite an example, on pp. 100–105, under the heading saliva and dental caries, he devotes no more than fifteen lines to saliva, but has something to say about fourteen other topics. The text, throughout, is characterized by lack of attention to the main theme and the insertion at frequent intervals of bits of irrelevant information. The author's interest is clearly in the clinical description of what one sees in carious mouths, and in what constitutes effective treatment, rather than in the nutritional and biochemical aspects of tooth development and tooth preservation. The illustrations are instructive and well chosen, and are worthy of careful study by anyone interested in dental pathology.

E. V. MCCOLLUM

WHAT YOU CAN DO FOR HIGH BLOOD PRESSURE.

By Peter J. Steincrohn. Doubleday & Company, Garden City, New York. $2.50. 191 pp. 1947.

To his list of books written especially for the layman, Steincrohn has now added this thoroughly readable treatise on high blood pressure. In clear, non-technical language the volume deals with present medical knowledge of the signs, symptoms, and probable causes of high blood pressure, as well as the prescribed treatment and care of the hypertensive patient. The underlying theme of the book is a plea for the development of an attitude of common sense and moderation in all the activities of a patient with high blood pressure, in his work, his exercise, his eating, and his use of stimulants. Warnings against the practice of self-diagnosis and the use of home remedies and patent medicines are frequent. Considerable effort is made to dispel many of the erroneous concepts regarding high blood pressure so prevalent today. Many commonplace similes are drawn to clarify the principles discussed. Numerous case histories are used to stress points of particular interest.

B. AUBREY SCHNEIDER

PENICILLIN IN SYPHILIS.

By Joseph Earle Moore. Charles C. Thomas, Springfield, Illinois. $5.00. x + 319 pp.; text ill. 1946.

This book is written by one of America's outstanding authorities on syphilotherapy. It is well written, and each of its nineteen chapters contains an excellent and adequate bibliography. It is more than a treatise on the use of penicillin in the treatment of syphilis, because the first five chapters contain useful and accurate information on the chemistry of penicillin, as well as the pharmacology of this antibiotic, up to the time of the writing of the book. This portion of the book also contains information on the toxicity of penicillin in animals and man, as well as on the activity of penicillin, in vitro and in vivo, from a general standpoint. This general behavior of penicillin is considered in relation to its antispirochetal activity.

Beginning with chapter 6, the monograph is devoted to the use of penicillin in experimental and clinical syphilis. Concise and accurate information is given concerning its use in the treatment of early and late syphilis and the prevention of prenatal syphilis, congenital syphilis, and in the syphilis of various systems, including neurosyphilis. This division of the material makes the monograph extraordinarily useful for the clinician who must attempt to administer the antibiotic agent intelligently in the treatment of this disease. The volume contains a final chapter on streptomycin in syphilis.

Like other monographs of this type, the book suffers because of the rapid advances and changes that are occurring in the whole field of the antibiotic therapy of spirochetal infections. Yet, if changes already render many of the recommendations obsolete, the book will still remain of considerable historic value to those interested in the general subject. From a clinician's standpoint, it is a real contribution. The biologist, however, will find very little in it to interest him.

WALLACE E. HERRELL

THEORIES ON MUTATIONS AND THE FORMATION OF SOME BENIGN AND MALIGNANT TUMORS.

By Manuel D. Hornedo. The William-Frederick Press, New York. $2.00. 63 pp.; ill. 1947.

This little book or bound pamphlet has one appropriate and commendable feature—it is brief. It is a statement of the author's speculations on the cause of neoplastic diseases and on possible methods to prevent and cure malignant tumors. The hypothesis it mentions is derived from a superficial examination of past and present theories and is supported by no data of any kind. There are no references and no index. The book is copiously illustrated with meaningless illustrations. Many of the illustrations appear to be misleading in that they might create the impression that considerable work has been done in the preparation of anti-malignin, a hypothetical prophylactic vaccine. Even a non-critical reading of the text reveals that these illustrations only show how such a vaccine could be made, and how it could be used to immunize against cancer and also to determine individual susceptibility to cancer.

FRANK H. J. FIGGE

CHRONIC DISEASE AND PSYCHOLOGICAL INVALIDISM: *A Psychosomatic Study. Psychosomatic Medicine Monographs.*

By Jurgen Ruesch in collaboration with Robert E. Harris, Carole Christiansen, Susanne H. Heller, Martin B. Loeb, Sally Dewees, and Annemarie Jacobson, with a foreword by Karl M. Bowman. Published with the sponsorship of The American Society for Research in Psychosomatic Problems, New York; Paul B. Hoeber, New York. $3.00 (paper). x + 191 pp. 1946.

This monograph owes its timely publication to a keen awareness that in illness "the personality of the patient is in some cases as important, if not more important, than the disease process itself" and that "while many patients desire quick and complete recovery, others find that a continuation of symptoms may be a satisfactory way to dominate or punish others, to gain prestige, to evade unpleasant duties, to obtain compensation, or to achieve some other desired goal." The investigation was undertaken and carried through at the University of California Medical School and the Langley Porter Clinic, in order to ascertain not only the personal but also the social and cultural factors determining or associated with delayed recovery from illness. With the ultimate goal of therapy in mind, some 123 out- and 64 in-patients were selected as typical of delayed recovery cases and were subjected to intensive medical, psychiatric, psychological, and socio-cultural status examination.

A careful and useful distinction is drawn between the cases with and without abnormal physical findings, with a further separation of those with physical disease having psychological complications, and those psychoneurotics "with physical complications," which the authors regard as being "brought about in the majority of cases by physical treatment." In 91 per cent of the sample the symptomatology of the delayed recovery patients featured pain, gastro-intestinal complaints, and anxiety.

Besides being disproportionately of the middle class in numbers, comparison of "their personality features showing abnormalities with those approximating the norm warrants the conclusion that cases of delayed recovery are characterized by an absence of overt misbehavior or conduct disorders. Instead, maladjustment is expressed in terms of disease, sexual, and

marital difficulties." These psychophysiological symptoms are probed in the sections devoted to Psychosomatic Relations, Situational Conflicts, and Character Problems, and in summary terms the authors describe the patients "as being on one hand, dependent, conformant, and in need of guidance; on the other hand, as striving for recognition but attempting to avoid blame and responsibility. Because of an excessive degree of self-love, they were unable to enjoy life in terms of play or sexual participation. The men were dependent and unaggressive; the women dominant, aggressive, and overprotective." In terms of socio-cultural status (Social and Cultural Factors in Delayed Recovery) some "75 per cent of the cases with delayed recovery belonged to the lower middle class as compared to about 28 per cent in the normal population. . ."revealing". . . a defense characteristic of the lower middle class, disease proneness and delayed recovery." Popular medical "ideology," the doctor, and our system of medical care are "put on the spot" in well-taken and pointed criticisms in Some Psychological Problems in Medicine, a section which is devoted to lively discussions of the frigid woman, venereal disease, abuse of operations, medicine, diet, and rest, and the problems of the "perpetually referred patient."

Short psychotherapy was undertaken on an individual and group basis with a view toward "restoring the patients to the same state of adjustment that prevailed before the breakdown, thus preventing a more or less permanent fixation of [physical disease] symptoms." The authors report considerable success with their ingenious theoretical development and use of short psychotherapy for "helping patients over an acute phase of maladjustment." The reader will be disappointed in the omission of quantitative data on their successes and failures, results being described by the authors only in the most general terms, e.g., "Short psychotherapy. . .is. . .suitable for the patient with education limited to high school and with I.Q. not exceeding 110." One wonders what assurance of future health the patient perennially prone to illness might enjoy merely by returning to his last illness status!

The sympathetic reviewer hesitates to diminish any instructive and potentially useful achievement in any too neglected area of study, and certainly this is one. Yet, since the authors have given so extended an emphasis to the social and cultural factors in delayed recovery, their sweeping generalizations concerning them require scrutiny. Three points of general criticism in this connection should be made. First, inadequate recognition has been assigned to the limitations and bias of the sample of subjects selected for study. Second, no control group was included. Since no non-delayed-recovery patients were studied in parallel, one would expect greater caution in the designation of socio-cultural attributes than the writers have expressed in their characterization of delayed-recovery vs. non-delayed-recovery patients. In almost every instance (with the notable exception of certain comparative psychological test data) the "abnormalities" of delayed-recovery patients are assessed with reference to a hypothetical and not an empirical norm. And, third, in view of the far-reaching import of the conclusions reached, the authors have obligated themselves beyond their performance. Their description of the modus vivendi of the lower middle class is largely subjective and goes far beyond the scope of their meager criteria, especially in distinguishing middle and lower-middle class motivation, needs, frustrations, goals, etc., from those of other classes. Within the framework of these criticisms, nonetheless, this book is a positive contribution to medicine's socio-psychological field of inquiry. Although it falls far short of convincingly distilling out and identifying the socio-cultural determiners of psychological invalidism, it should be read for its successful analysis and description of the manifold personal and social involvements of these delayed-recovery patients and the documentation of the many penetrating clinical insights which their study afforded.

JOSEPH C. FRANKLIN

ADVANCES IN MILITARY MEDICINE *Made by American Investigators Working Under the Sponsorship of The Committee on Medical Research. Volumes I and II. Science in World War II, Office of Scientific Research and Development.*

Edited by E. C. Andrus, D. W. Bronk, G. A. Carden, Jr., C. S. Keefer, J. S. Lockwood, J. T. Wearn, M. C. Winternitz; associate editor, Tuckerman Day; foreword by Alfred N. Richards. An Atlantic Monthly Press Book, Little, Brown and Company, Boston. $12.50 set. liv + 472 pp. + 22 plates; text ill.; xx + pp. 473–900 +10 plates; text ill. 1948.

Advances in Military Medicine is a 2-volume report that recounts the results of the effort of the Committee on Medical Research in the interests of our National Defense. During its five years of operation, the CMR engaged the time and activity of some 1700 professional men and 3800 technicians, and spent approximately 25 million dollars. This book will be of interest to the public as a series of non-technical reports dealing with the developments that led to some of the Committee's dramatic accomplishments, e.g., aborting the typhus epidemic in Italy in 1943, developing atabrine, producing penicillin in large quantities, and applying methods to permit our pilots to fly higher, faster, and safer, to mention only a few. Being a series of non-technical reports, it will be of limited interest to the biologist or physician, however, since the accounts are not designed as comprehensive reviews. But

undoubtedly scientists and educators will be interested in the manner in which the public reacts to these and similar reports, for the nature of the support that science will receive in the future will depend in part on how the public interprets the results of "organized science" during World War II.

DAVID B. TYLER

PSYCHOLOGY AND ANIMAL BEHAVIOR

FOUNDATIONS OF PSYCHOLOGY.

Edited by Edwin Garrigues Boring, Herbert Sidney Langfeld, and Harry Porter Weld. John Wiley and Sons, New York; Chapman and Hall, London. $4.00. xvi + 632 pp.; ill. 1948.

This is an elementary textbook which approaches a handbook in comprehensiveness. It has 632 large double-column pages, containing 25 chapters written by 19 contributors and polished by 3 editors. The content repeats very little of the earlier texts by these editors (*Psychology, a factual textbook*, 1935; *Introduction to Psychology*, 1939; *Psychology for the Armed Services*, 1945) but the general approach shows derivations from each. Although the whole field of modern psychology has been covered, the subject matter continues in this text to emphasize experimental, as opposed to clinical material; for example, there is an entire chapter on topographical orientation, but scarcely more than two pages on projective techniques, although the latter occupy a much larger portion of the contemporary literature of psychology.

The style is objective, and the treatment is more exhaustive than is usual in elementary textbooks. The illustrations are for the most part either diagrammatic or in the form of graphs. A few are taken from the earlier editions. Although the language used is fairly simple, probably revealing a Flesch influence, it is straightforward and does not appear to be padded for reader interest in the manner possibly true of certain other recent elementary books. The coverage is also broader than usual, including for instance the new chapter on topographical orientation mentioned above, and a chapter on attitudes and opinions with an interesting discussion of polling, in addition to standard topics.

Visual aids for use with this book are obtainable from the publisher. These include slides on the subject matter of each chapter, a few of which are the same as illustrations in the text, several motion pictures, and a film strip.

It is doubtful whether this text would be perfectly suited for use in a one-semester course, as the publishers suggest, but it is probably the most authoritative elementary textbook on the market, providing a sound foundation for the student who intends to do further work in pyschology, and yielding a good insight into its general subject matter for the non-specialist.

HOWARD D. BAKER

PSYCHOLOGY AND LIFE. *Including Illustrated Reference Manual: The Brain and Nervous System. Third Edition. By Floyd L. Ruch. Scott, Foresman and Company, Chicago, Atlanta, Dallas, and New York.* $3.75. xvi + 782 pp., ill. 1948.

This is the third edition of a widely used elementary textbook in general psychology, written for college undergraduates. The author's original intent, retained in this edition, was to provide a text which emphasizes topics of interest to students rather than those topics on which most research has been done. Such an approach may be subject to the criticism that it accepts the layman's definition of psychology and subsequently warps the subject matter of the academic psychologist's science to fit. However, this criticism is more valid for the earlier editions than for the present one, which represents a degree of regression toward a more traditional treatment. For example, the first edition did not contain the usual section on the nervous system, whereas the present edition contains an excellent summary of elementary neuroanatomy and physiology, written by Theodore C. Ruch and appended to the volume as a "reference manual." The general aim nevertheless remains directed at students' interests, and the clinical and experimental material reported is always related to his needs and concerns. Together with the many good illustrations, this results in a readable and absorbing book.

A 309-page workbook and an accompanying instructor's manual, paralleling the subject matter of the textbook, are available from the publisher to supplement the text with extensive exercises. A chapter-by-chapter battery of objective test items based on the book is also available.

The readability and general orientation of this book make it particularly suitable for one-semester courses in psychology, or for classes for students who do not intend to specialize in the subject.

HOWARD D. BAKER

PSYCHOLOGY: GENERAL AND APPLIED.

By L. B. Hoisington. Published by the author, University of Oklahoma, Norman, Oklahoma; J. W. Edwards, Ann Arbor, Michigan. $1.50 (paper). vi + 220 pp.; ill. 1946.

This lithoprinted edition is intended to be a textbook for courses in elementary psychology. The first part is called The Facts and Principles of Normal Human Functioning and takes up in its nine chapters a consideration of what psychology is and is not, the field of

psychology, sensory experience, meaning, adjustments and determinations, muscular reactions, perception, ideas and ideation, and feelings. The second part deals with the application of these facts and principles to every-day life. It has five chapters on learning, intelligence, personality and mental hygiene, man and his social order, and occupational groups respectively. At the end of each part there is a set of exercises, in the form of questions and spaces for answers for each chapter in that part.

A paper-covered, 8½″ by 11″ volume, the book is apparently intended for a popular and rather elementary course in introductory psychology. It is written in a readable style and has many interesting examples. Although the book has a good scientific point of view, the facts given are somewhat sparse and many important topics are omitted that should have a place in any elementary textbook. Nevertheless, this one can be of value as a simple and inexpensive textbook for a brief and rather elementary introductory course in psychology.

ELIOT STELLAR

PHYSICS AND EXPERIENCE. *The Henry Sidgwick Lecture delivered at Newnham College, Cambridge, 10 November, 1945.*

By Bertrand Russell. Cambridge, at the University Press; The Macmillan Company, New York. 75 cents (paper). 26 pp. 1946.

This highly stimulating and provocative lecture may be summarized in the author's own clear language: "Our main question was: If physics is true, how can it be known, and what, besides physics, must we know in order to infer physics? This problem arises through the physical causation of perception, which makes it probable that physical objects differ greatly from percepts; but if so, how can we infer physical objects from percepts? . . . we are confronted with the old problem of the relation between mind and matter. My own belief is that the 'mental' and the 'physical' are not so disparate as is generally thought. I should define a 'mental' occurrence as one which some one knows otherwise than by inference; the distinction between 'mental' and 'physical' therefore belongs to theory of knowledge, not to metaphysics. One of the difficulties which have led to confusion was failure to distinguish between perceptual and physical space. . . .

"Percepts, considered causally, are between events in afferent nerves (stimulus) and events in efferent nerves (reaction); their location in causal chains is the same as that of certain events in the brain. Percepts as a source of knowledge of physical objects can only serve their purpose in so far as there are separable, more or less independent, causal chains in the physical world. This only happens approximately, and therefore the inference from percepts to physical objects cannot be precise. Science consists largely of devices for overcoming this initial lack of precision on the assumption that perception gives a first approximation to the truth."

PHYSIOLOGICAL PSYCHOLOGY.

By G. L. Freeman. D. Van Nostrand Company, New York, Toronto and London. $4.50. x + 530 pp.; ill. 1948.

This book is a revision of the author's *Introduction to Physiological Psychology*, published in 1934. Like the older book, it is divided into four parts: The Basic Mechanisms of Behavior; The Structure-Functional Organization of Bodily Mechanisms; The Integrative Action of Bodily Mechanisms; and Bodily Mechanisms and Viable Behavior. The only changes in the basic material in these parts of the book are perhaps reflected in their slightly modified headings. The term "neural" has been dropped from the first, and has been replaced by the term "bodily" in the last three. The twenty-eight chapters of the new book are titled and organized in almost the same way as the chapters of the old one. Two new chapters have been added, one on the ducted and ductless glands and one on subcortical integrations. The chapter of the old book on the sensory functions of the cortex has been included in the new chapter on cortical integration, and the chapters on intelligence and temperament are now combined into a single chapter on personality.

Taken as a whole, the new book does not represent much of a revision. Some effort has been made to cover the literature since 1934, but it is by no means exhaustive. The author seems to rely on the older concepts and the older literature of psychology. A rough count of the number of references cited by the author indicates that only about 30 per cent come from the literature of the last ten years. Much of the important and stimulating work of those years has been omitted, and entire fields of research in physiological psychology that have recently developed have been overlooked. Furthermore, many of the aspects of physiological psychology that the book does cover are given rather elementary and sometimes only cursory treatment.

ELIOT STELLAR

HORMONES AND BEHAVIOR. *A Survey of Interrelationships Between Endocrine Secretions and Patterns of Overt Response.*

By Frank A. Beach, with a foreword by Earl T. Engle. Paul B. Hoeber, New York and London. $6.50. xvi + 368 pp. 1948.

This is an extremely timely and useful monograph. With the isolation and crystallization of hormones advancing on the one hand and with the rapid develop-

ment of behavioral techniques on the other, there has been an increasing volume of research on the relation between hormones and behavior. This work has become more and more important to biochemists, endocrinologists, physiologists and psychologists. Just as the volume and diversity of the research was beginning to overwhelm these various investigators, Beach has made this comprehensive and scholarly summary of the field.

No hormone, no species of animal, and no aspect of behavior seems to have been omitted in his searching survey. The chapters cover Courtship and Mating; Reversal or Bisexuality of Mating Behavior; Oviposition, Parturition, and Parental Behavior; Migration; Generalized Aggression, Social Dominance or Submission, and Territory Defense; Emotion; Conditioning and Other Types of Learning; and General Locomotor Activity—all of the aspects of behavior influenced directly or indirectly by hormones. Then later, various anatomical and physiological intermediates in the influence of hormones on behavior are summarized in chapters entitled Homeostasis, Metabolism, Metamorphosis, and Moulting; Morphologic Structures Employed in Specific Behavior Patterns; The Role of Nervous Stimulation; and Developmental Aspects. In all of these chapters, a phylogenetic point of view is kept, one that utilizes all available data from the phyletic series.

An excellent feature of the book is its clear separation of facts and interpretations. The chapters just named enumerate the facts in a straight-forward fashion, relatively free of interpretation. In two final chapters, however, Beach brings out the meaning of the data he has previously summarized. In one chapter, Major Sources of Variability, he brings out many problems of conducting research in this area and delineates the multitude of factors which are at work, simultaneously or successively, in any behavioral effect of hormone action. In the last chapter, Interpretations of Hormonal Effects, he outlines a number of generalizations which seem to cover the present state of our knowledge. These generalizations will certainly provide valuable hypotheses for future research.

The book is certainly not a textbook, although it may be very useful for advanced seminars in the various fields concerned with hormones and behavior. It is certainly a useful reference work for all who are concerned in the least, whether practitioners or research scientists, with the effect of hormones on behavior. The statements in the book are documented with a bibliography of about 800 titles, which it is certainly helpful to find in one place. The book, moreover, includes a Glossary which will help the somewhat bewildered student or scientist as he reads the literature in the field.

If the book has any faults, they appear to lie in two directions: first, it appears that the literature is sometimes reported uncritically. The author does not always say which experiments are "good" ones and which are not. He records what investigators have reported in the literature without evaluation. Secondly, the style of writing is in many places a bit like machine-gun fire. Fact after fact is stated in rapid succession, without transition or integration. These, however, are minor faults, not to be emphasized and not characteristic of all chapters in the book.

An over-all evaluation of the book must recognize that it is a comprehensive, scholarly work, that it provides a fair picture of our facts and present understanding of the area, and that it will be a valuable asset to advanced students, research workers, and practitioners interested in hormones and behavior.

C. T. MORGAN

WORK AND EFFORT. *The Psychology of Production. By Thomas Arthur Ryan. The Ronald Press Company, New York.* $4.50. xii + 323 pp.; ill. 1947.

Ryan's book is a systematic survey of investigations on the productivity of men and women at work. The researches he reviews come from three major areas: physiology, psychology, and time-and-motion engineering. Although it might appear at first glance that this is just another book on industrial psychology, its contents differ considerably from what one finds in most texts bearing such a title. The scope of this book is best indicated by a listing of the chapter headings: The Meaning of Efficiency or Economy of Work; Measuring the Cost of Work: I. Metabolism and Muscular Fatigue; II. Fatigue in Sedentary Work; III. Physiological Tests of Effort and Fatigue in Sedentary Work—Statistical Indices of Efficiency; Specific Factors Governing Efficiency and Productivity; Work Methods and Efficiency; Incentives and Motives; "Nervous" Fatigue and Boredom; Time Standards and Rate Setting; Merit Rating and Job Evaluation; Psychological Problems in Accident Control; and Skill and Practice.

This book should be useful to applied psychologists, industrial managers, and personnel directors because it presents conclusions drawn from a large number of studies on productivity. In addition, the author has described the methodology employed in the original researches, so that the reader may not only learn about the way research is done in this field but may also judge the adequacy of those researches which have been done. All of this is accomplished in a manner interesting, readable, and easy to follow.

But the chief value of this book lies not in its summary of a large number of studies in a certain area, but rather in the critical way in which this summarizing has been done. The author has carefully examined and evaluated the original reports of research for their methodology, controls, the adequacy of the statistical analysis of the data, and the validity of conclusions. When thus evaluated according to modern ideas of

rigorous experimentation a surprising percentage of the early studies on mental and physical work appear very inadequate. There is need for a great deal of careful work in this field and Ryan clearly shows why. This is a carefully written, thought-provoking text which has much to commend it to students and research workers alike.

A. CHAPANIS

INDUSTRIAL PSYCHOLOGY. *Second Edition.*

By Joseph Tiffin. Prentice-Hall, New York. $5.35. xxii + 553 pp.; ill. 1947.

This is a revised edition of a book first published in 1942. The scope and range of the author's treatment of the field may best be conveyed by listing the book's contents, which devotes a chapter to each of the following: Significance of Individual Differences in Industry; The Interview and Related Employment Methods; General Principles of Employee Testing; Mental Ability and Mechanical Aptitude Tests; Dexterity, Manipulative, and Achievement Tests; Tests of Personality and Interest; Visual Skills and Vision Tests; Training of Industrial Employees; Industrial Inspection; Industrial Merit Rating; Wages and Job Evaluation; Work, Fatigue, and Efficiency; Accidents and Safety; and Attitudes and Morale.

Two chapters are new, The Interview and Related Employment Methods, and Wages and Job Evaluation. Others have been reworked to include pertinent findings which have accrued since publication of the first edition. During this period industrial psychology has boomed as its practice and practitioners were employed in the feverish and concerted effort to meet demands for full production and optimum allocation of manpower for war purposes.

In the book, typically a textbook in organization and style, the emphasis remains on providing the student with an overview of the general field, and in particular on equipping him with basic skills, techniques, and methods for handling a wide variety of industrial personnel and production problems. Elementary Statistical Procedures, the Taylor-Russel Selection Tables, and a comprehensive list of publishers of tests are included in the appendices.

By and large the author has improved his already competent book within the context of his original presentation. Many would consider his treatment of vision, which reflects his own particular interest, disproportionately long compared to the space devoted to such other topics as personality, attitudes, or morale. Textbooks in this field shy away from socio-psychological concern with the influence of *man* as a producer on the instrumentalities and organization of production and upon their reactive influences on him, and with the ethical and value questions which inevitably are raised. This book is no exception. But, having made this observation, one hastens to add that the book is probably the best general textbook available.

JOSEPH C. FRANKLIN

AUTHORITY AND FRUSTRATION. *Studies in Topological and Vector Psychology III. University of Iowa Studies: Studies in Child Welfare, Volume XX.*

By Kurt Lewin, Charles E. Meyers, Joan Kalhorn, Maurice L. Farber and John R. P. French; edited by Robert R. Sears. University of Iowa Press, Iowa City. $1.50 (paper). viii + 308 pp.; ill. 1944.

This is a series of five separate studies done under Kurt Lewin at Iowa University, in which observations are made and conclusions drawn in regard to different group reactions to situations that involve reactions to authority or to frustration. The work is carefully done and intelligently reported. However, much of it is highly technical. It is safe to say that it will be of interest only to readers well-versed in the field of experimental psychology.

HELEN ARTHUR

PSYCHOLOGY OF PERSONALITY.

By Robert Leeper. Published by the author, University of Oregon, Eugene, Oregon; J. W. Edwards, Ann Arbor, Michigan. $2.00 (paper). vi + 167 pp.; ill. 1946.

This volume is an attempt to make practical an introductory course in the field of personality. The treatment is not of the usual popular kind, that is, there has been no attempt here to reduce the vocabulary to a fifth-grade level; but the style is informal and in general painless. The question-and-answer technique is exploited rather fully. Each chapter title is presented as a question, while within the chapter the procedure is that of broaching questions and working out the answers. Material having a popular appeal is also introduced extensively by way of illustration and analogy. Sketches and diagrams, of a somewhat crowded and humorous type, are also used to illustrate and emphasize principles. In general, case material is also very freely utilized, with the individual's identities carefully safe-guarded.

By the term personality the author means three things: first, the individual's motives; second, the techniques by which he tries to satisfy these motives; and third, the background of meanings which determine the motives. Particularly interesting is the discussion of personality guidance by the person himself or by non-psychologically-trained people. In view of the present concern of the American Psychological Association over the charlatans and quacks now operating in this field and probably greatly outnumbering trained workers, it is somewhat surprising to find

Leeper presenting as his point of view that only extreme maladjustments need the guidance of experts. The question comes to mind: who is to determine the degree of maladjustment?

Typical of the author's optimistic approach is the chapter titled How May A Person Develop Some Superior Personality Characteristics? Using the analogy of a change in one's handwriting, Leeper arrives at six principles of habit-changing, which he then proceeds to apply to the changing of personality. These principles include motivation, evaluation, sufficient practice, etc. The importance of first knowing one's own characteristics before attempting to change them is brought out; however, little consideration is given to formal tests in this field. Indeed, only two are mentioned, The Ascendance-Submission Test of Allport, and the Study of Values. The author's attitude toward tests is indicated by the following quotation: "They can not tell you nearly as much about your personality as someone could tell you who was really understanding and who knew you quite well" (p. 117). In the next chapter there follows a discussion of the changing of personality faults, one method suggested being Dunlap's negative practice technique (Beta-Hypothesis).

One of the best chapters is that entitled: What Are The Differences Between Good and Poor Adjustment-Techniques? Although the treatment here is by no means new and is to some extent necessarily oversimplified, such topics as rationalization, repression, hysteria, overaggressiveness, and negativism are very well presented and illustrated in this chapter. Each chapter concludes with a summary which brings out its essential point. Despite the lithoprinted two-column format, the book is not inconvenient to handle.

ARTHUR LICHTENSTEIN

STUDIES IN CHILD DEVELOPMENT.

By Arnold Gesell. Harper & Brothers, New York and London. $4.00. x + 224 pp.; ill. 1948.

This latest book by Gesell is a collection of separate papers originally presented, for the most part, elsewhere. The result is a very minor work indeed compared with some of the author's previous contributions to the field of child development. There is indeed nothing really new in this compilation, in which Gesell appears to be shaping his material to fit such an occasion as an inaugural address at The Museum of Science and Industry in Chicago or a Conference on Special Education.

It is a pleasant book to read, however, and the author's mellow and mature philosophical approach to his material permeates the pages. Even in such a loosely connected group of studies, Gesell's genius for organization draws the disparate papers together into a semblance of a unity. Despite these positive values, however, it is hard to believe that the volume will add much of worth to anyone's library.

HELEN ARTHUR

CHILD PSYCHOLOGY. *Third Edition.*

By Arthur T. Jersild. Prentice-Hall, New York. $5.00. xii + 623 pp.; ill. 1947.

This is the revised third edition of a well-known textbook on child psychology which first appeared in 1933. Jersild employs a pleasant, readable style which greatly enhances his book's value as an effective teaching aid. In addition to this, he covers the field intelligently and understandingly, yet with a professional perspective which precludes obvious bias or sentimentality. Altogether it is a good book for an introduction to child psychology at the college level.

HELEN ARTHUR

CHILD AND ADOLESCENT LIFE IN HEALTH AND DISEASE. *A Study in Social Paediatrics.*

By W. S. Craig, with a foreword by Charles McNeil. E. & S. Livingstone, Edinburgh; Williams & Wilkins Company, Baltimore. $7.00. xvi + 667 pp.; ill. 1946.

Craig has produced a most complete reference book, dealing with the cultural development of English pediatrics in the widest sense of that term. Beginning with the end of the 16th Century, he traces factually the evolution of society's interest in destitute children, sick children, school children, and delinquent children. He brings his account up to date in Part II by giving again a factual report on where 20th Century England stands with regard to child care in public institutions and clinics and through charitable organizations. He cites at length the various laws relating to child and adolescent welfare. For mere reading, this is an exceedingly dry book, but it may be of interest or use to students of social development. The fact that the material is confined to a study of social pediatrics in Great Britain reduces its potential interest for U. S. readers, although it may well be argued that many of our own social attitudes toward children stem from reforms and experiences in the Mother Country.

HELEN ARTHUR

PSYCHOPATHOLOGY AND EDUCATION OF THE BRAIN-INJURED CHILD.

By Alfred A. Strauss and Laura E. Lehtinen. Grune and Stratton, New York. $5.00. x + 206 pp.; ill. 1947.

This is a clinically oriented book written by two people who have had a great deal of personal experience in

working with brain-injured children. Their approach is pragmatic rather than pedantic. After reading so compact a little book, the professional reader will have a much clearer idea of how to approach the differential diagnoses involving brain-injured children and how to direct the learning processes for such youngsters. It is a very practical and worthwhile presentation.

HELEN ARTHUR

THE PSYCHOLOGICAL ORIGIN AND TREATMENT OF ENURESIS. *A Practical Discussion of Bed-wetting.*

By Stevenson Smith. University of Washington Press, Seattle. $1.75. x + 70 pp. 1948.

In spite of its provocative title, this little volume is far from being a major contribution to the solution of the ever-present problem of bed-wetting. Stevenson Smith is either uninformed in regard to any of the psychodynamic formulations applying to enuresis or he has smugly dismissed them as completely useless. The result is a one-dimensional, unsophisticated, so-called "Practical Discussion" directed somewhat scoldingly at the parent who is responsible for it all. The parent is adjured to behave better toward the child and then to begin a retraining program consisting, essentially, of thoroughly awakening the child for his nocturnal voiding and of using devices to arouse the child at the first signs of dampness. This process will condition the sleeping child to awaken at the stimulation of a full bladder, and the situation will be solved, says the author.

HELEN ARTHUR

THE ENGRAMMES OF PSYCHIATRY.

By J. M. Nielsen and George N. Thompson. Charles C. Thomas, Springfield, Illinois. $6.75. xx + 509 pp.; ill. 1947.

What started out to be, according to the authors, "an anatomy and physiology of human behavior" on the assumption that "all psychology is cerebral physiology" ends by being a curious admixture of untutored notions about the fundamentals of human behavior, of which—in terms of modern psychology—the authors know very little, and of diagnosis, management, and treatment of mental illness, about which, as practicing psychiatrists, they obviously know a great deal.

On the one hand, Nielson and Thompson have gone beyond the physiological limitations they set for themselves in the field in which they are familiar, practical psychiatry, and on the other hand they have exercised a blind and uncritical reductionism in their handling of behavioral theory, the bulk of which seems not so much rejected (either with or without evidence) as simply unknown to them. To give but one example, only seven pages are devoted to a discussion, largely superficial, of personality and character—which they assert are "basically hereditary because of their diencephalic patterns." Accordingly, hereditary factors are stressed by the authors and buttressed by the elaboration of outdated and untenable instinct theories.

It follows that where direct knowledge from corrective experience has not superseded their notions of human behavior—static and pseudo-determined as the authors hold them—subsequent errors may be expected to show up in their psychiatric orientation. Occasionally this does happen. Fortunately, most of the book, devoted to classification, diagnosis, and description of mental illness, is standard along traditional lines, with the emphasis placed on physiological correlates. Where not neglected entirely, psychotherapy tends to be discussed only casually. However, the authors deserve credit for their espousal of the importance of psychosomatic and gerontological problems in psychiatric medicine.

The authors have adopted a thesis which at our infantile stage of knowledge in this area it is difficult to support. To have achieved even a measure of success would have required of them much more objective and unequivocal evidence, less self-assurance, and considerably more incisive thinking than they have brought to the task.

JOSEPH C. FRANKLIN

CREATION CONTINUES. *A Psychological Interpretation of the First Gospel.*

By Fritz Kunkel. Charles Scribner's Sons, New York. $3.00. xvi + 317 pp. 1947.

This book is neither a study of evolutionary processes, as its main title might be taken to imply, nor a psychological analysis, as the subtitle would indicate. The author may indeed be a psychologist, but there is nothing to differentiate this volume from standard religious criticism. This is a suitable occasion to protest against the misuse of the term "psychological" in books—and especially in their titles—when they are psychological only in being the product of a human mind.

BENTLEY GLASS

HUMAN BIOLOGY

OUTLINE OF ANTHROPOLOGY. *College Outline Series. By Melville Jacobs and Bernhard J. Stern. Barnes and Noble, New York.* $1.25 (paper). xiv + 332 pp. 1947.

Since men are less able to take themselves for granted in the face of the stunning fact that they themselves constitute the foremost threat to their own collective and individual survival, the influence and literature of

anthropology has grown by leaps and bounds. Ever greater numbers have at last, in their effort to make their way through the entanglements of complex and potentially overwhelming forces, come to believe with Pope that "the proper study of mankind is man."

Happily, among the more avid of these are the college and university students for whom this book is primarily intended, to serve as an introductory "outline whose purpose is to chart all the main highways in present-day anthropology."

These "main highways" have been laid down by the authors through all the areas of anthropology. They are well-paved, and have been laid out to provide the novice traveler with an academically substantial, pleasant, and diversified panorama of *man* and his works.

Our geographers of the Province of Man have subdivided it into well-balanced sections, with more extensive tours in those areas of cultural anthropology that elicit the greatest contemporary interest and are likely to be more appealing as well as more significant for the student. The older and more academic territories of anthropology have not been omitted from the itinerary and are succinctly displayed in sections devoted to linguistics, prehistory, and physical anthropology. Notwithstanding occasional discontinuities in the view, especially where topical treatment has blurred our glimpse of communal life in situ, the excellent purview provided by the authors will undoubtedly open up a new world of appreciation for the variety and diversity of historical and contemporary human ways of life. Strategically placed bumps and holes have been deliberately located at places along the road calculated to jar a complacent and subjective traveler into clearer vision and a more objective perspective where ethnocentrism is an untrustworthy but beguiling eye-piece.

A glossary, index, and a useful tabulated bibliographic schedule of standard textbooks in anthropology are especially valuable additions to the map provided. Moreover, the authors have included suggested tours at the end of each stage for those who wish to strike out on their own for more intimate and intensive explorations than the escorted tour permits. To those who wish, though with limited time and purse, to acquaint themselves with the Province of Man, in retrospect and prospect, the well-conceived and executed tour the authors have devised is heartily recommended.

JOSEPH C. FRANKLIN

DIE ANTHROPOLOGIE DER EIDGENOSSENSCHAFT. *Anthropologia Helvetica, I. A. Textband, B. Atlas. Archiv Der Julius Klaus-Stiftung, Erganzungsband, Volume XXI, 1946.*

By Otto Schlaginhaufen. Art. Institut Orell Füssli, Zurich. S.fr. 60.—(paper). A. vi + 699 pp. + 1 chart; ill.; B. 14 pp. + 81 maps + 168 plates. 1946. In the years 1927 to 1932 a total of 35,511 Swiss military recruits were examined anthropometrically by uniformly trained observers. These recruits averaged in age 19 years and 3 months (± ca. 6 months) and, as residents, represented all parts of Switzerland. The following measurements were taken on every individual: stature, sitting height, span, head length and breadth, breadth of forehead, face breadth, total and upper face height, breadth between angles of lower jaw, two breadths appertaining to eyeclefts, nose height and breadth, and the angle of the facial profile. In addition the general shape and color of the head hair and the color of the eyes were recorded, and the profile of the nose and of the occiput was determined according to three types for each of these two features. These data, together with an elaborate and careful statistical analysis, form the basis for the present voluminous report. Each character is discussed according to all aspects of its variability and its geographical distribution within Switzerland (by cantons) and is then briefly compared with corresponding data for some other European groups. The percentage relations between different measurements, following standard anthropological usage, are also fully recorded and illustrated by frequency polygons and maps of distribution.

The second half of this monograph deals with the combinations between different characters, including indices, in individuals. The combinations between two features only are discussed in full detail, and their frequencies are tabulated even for the cantonal series. The frequencies between the possible combinations between three to six features are listed for the entire material only, without consideration of subgroups. Even these multiple combinations have been printed in tabular form at, undoubtedly, great expense. A more condensed publication of this particular analysis might have sufficed for the chief problem of this study: the racial composition of Switzerland.

The highest frequency of any specific combination of six characters consists, among young Swiss males, in the association of stature above 170 cm., cephalic index between 76.0 and 80.9, facial index between 88.0 and 92.9, nasal index between 55.0 and 69.9, iris color between "brown" and "light," and hair color "brown." This combination between these groups of variations exists in only 1.77 per cent of the entire series, and all other combinations are even less frequent. With such extremely conscientious standards, adapted to a literal interpretation of at least Deniker's definition of the races of Europe, the author reaches the conclusion that only 8.66 per cent of his very adequate sample of the Swiss population can be definitely assigned to one or another of the assumed "pure races" and that more than nine-tenths of it must be regarded as the product of racial intermixture. The author admits "dass es sich bei den europiden Rassen um hypothetische Rassen handelt, von denen die einen dem Wesen wirklicher

Rassen näher kommen, als die andern," but he lists these "races" in heavy type as *Homo Vistulensis, Homo Atlanto-Mediterraneus,* etc., just as if they were species (except for the curious capital letters starting the specific names). Some readers will find it surprising that nearly nine per cent of the present-day population of a Central European country can still be fitted into a scheme of six types, defined at best by optimistic idealizations and more or less arbitrary generalizations. Of other interesting findings may be specially mentioned the gradual increase in average stature during the past 60 or more years in Switzerland, as in other countries.

In writing this elaborate *Anthropologia Helvetica,* Schlaginhaufen has faithfully followed and applied the somatological aims and methods of his great teacher and predecessor, the late Rudolf Martin. The huge amount of reliable data forms a solid foundation for the anthropological investigation of Switzerland, but much remains to be added. For future comparisons with anthropological surveys of other countries, this monograph will be indispensable and highly useful.

A. H. SCHULTZ

MEN OUT OF ASIA.

By Harold Sterling Gladwin, with a foreword by Earnest A. Hooton; illustrated by Campbell Grant. Whittlesey House, McGraw-Hill Book Company, New York and London. $4.00. xviii + 390 pp. + 6 plates; text ill. 1947.

This is a daring but premature attempt to reconstruct the complete story of man in the New World from his earliest arrival up to the time of Columbus. Of the author, E. A. Hooton says in his Foreword and Hindthoughts that "he is an amateur [archaeologist], academically in that his record is not besmirched by a Ph.D. degree, and, in a pecuniary sense, because his hands are lily white" and goes on to vouch for the fact that "he has done as much dirt archaeology (which means real digging) in contrast to armchair archaeology (reading and speculating) as nearly any professional in the American field." It should be added here that, evidently, the speculating had all been saved for this book. Not having been conditioned to academic caution in reaching conclusions, the author merrily draws on his lively imagination in filling the many gaps in our present knowledge of American prehistory. He is steeped in the faith that the human mind cannot produce the same invention independently at different times or places and that, hence, all similarities in culture traits justify bold arrows on world maps to trace ancient migrations or contacts. Specific doubts and opposing views of others he brushes aside or ridicules as outmoded notions of "the Old Guard." In uninhibited and sweeping manner and with impatient disregard of final proof, the author outlines the full story of man's immigrations, intermingling, and development in America—as they might perhaps have occurred.

This is not a book for the lay reader in search of reliable information, but it provides very stimulating and entertaining reading for the anthropologist, who will find himself referred to at length as Dr. Phuderick Duddy, "the composite of all the great minds which have governed our anthropological thinking during the last 70 years." This Dr. Duddy "insists that the most primitive of men are his equals in intellectual potentialities" and "is steadfast in that he has never forsaken an idea once it has become imbedded." Even more amusing are the many delightful and most irreverent cartoons by Campbell Grant, which serve as illustrations for the highly original text, more argument than fact.

A. H. SCHULTZ

ANTHROPOLOGY. *Race, Language, Culture, Psychology, Prehistory. Second Edition.*

By A. L. Kroeber. Harcourt, Brace and Company, New York. $5.50. xii + 856 + xxxix pp.; ill. 1948.

In view of modern specialization it is quite natural that none of the existing textbooks of "anthropology" actually deals with, or is able to deal with, what is the literal meaning of anthropology: The Science of Man. Such a book would have to be based on an intimate knowledge of at least a dozen sciences (biology, ethnology, history, geography, archeology, economics, sociology, psychology, etc.), to master one of which is already an achievement for most of us. Yet this "new edition" of Kroeber's 1923 textbook of anthropology—actually a new book, completely overshadowing the older book, excellent as it was—comes closer to living up to its title than any other book this reviewer has ever seen.

The chapters on "race" (biological man) are based on a real understanding of the problem, and are as well integrated with the data on cultural man as is possible at our present state of knowledge. The three chapters on the prehistory of both hemispheres are a most lucid and up-to-date survey of the field. The acme and core of the book are the chapters on culture (especially the new chapters on the nature of culture, patterns, culture process, and culture change; the mostly older ones on culture growths and spreads, and distributions; and the stimulating chapter on cultural psychology). Together, they form the most illuminating existing treatise on culture. The author has obtained this result by intimately blending his profound knowledge of prehistory, history, ethnology, sociology, and psychology. Preserving the great traditions of the older anthropological authors and incorporating the best results of 25 years of modern research, in which Kroeber's own work on culture areas and culture

growth, among other things, ranks among the most conspicuous achievements, the book presents a most attractive mixture of youthful openmindedness, conservative wisdom, and scientific attitudes. The superiority of this analysis of culture, based primarily on history and ethnology, over other recent syntheses based exclusively on ethnology (plus some ill-understood borrowings from biology, sociology, or psychoanalysis), proves in a practical way the value of the historical approach to anthropology that has been defended theoretically by the author for many years (see especially his article in the *Amer. Anthrop.* 37: 539–569, 1935).

In view of recent scientific discussions on the relation between age and creativity, it may be worthwhile to mention that the author of this amazing book was born in 1876.

ERWIN H. ACKERKNECHT

THE COMMON DESCENT GROUP IN CHINA AND ITS FUNCTIONS. *Viking Fund Publications in Anthropology, Number 10.*

By Hsien Chin Hu. The Viking Fund, New York. $2.50 (paper). 204 pp.; ill. 1948.

The Chinese "common descent group" or tsu (called "clan" in many books on China) has been an important institution in Chinese history, especially in the Southeast, supplementing in many ways governmental activities. It is a patrilineal group, bound together by a common family name and veneration of a common ancestor. It owns halls for ancestor worship and land that pays for religious and charitable activities, and it maintains schools. It keeps up genealogies that, at best, go back to the 10th century A.D., when the institution was revived after a lapse of 300 years. It is one of the many effective expressions of Chinese association-mindedness. Hu's fine monograph describes the institution in all its details, such as judiciary functions, leadership, inter-tsu relations, etc., and is provided with 62 appendices from genealogies, documenting the author's general statements.

ERWIN H. ACKERNECHT

ECONOMIC MAN *In Relation To His Natural Environment. Volumes I and II.*

By C. Reinold Noyes. Columbia University Press, Morningside Heights, New York. $15.00 (two volumes). (I) xiv + pp. 1–692; (II) x + pp. 693–1443. 1948.

The title of this work is a misnomer, inasmuch as the author does not deal with what biologists usually regard as the natural environment, a factor he tends, in the case of man, to subordinate more or less completely to the "internal environment." The book might perhaps more properly have been called "Neurophysiology and Theoretical Economics." The author feels that the social sciences have to be disciples of the natural sciences in respect to material as well as methods. He therefore starts with a 245-page survey of the results of modern neurophysiology, quite an interesting and creditable performance in itself, backed up by 224 pages of appendices on the same subject matter. Unfortunately, on p. 246, Noyes discovers that the results of neurophysiology are so far rather irrelevant to his economic problems, diverting him into 150 more pages of psychology (on volition, *mneme*, effort), this time of the introspective variety ("metaphysical psychology") up to this point decried by him. Eventually he unburdens himself of a 600-page treatise on economic theory in the traditional vein, which is not in the domain of this journal and is so highly technical that only a specialist can fully assimilate and appraise it.

ERWIN H. ACKERKNECHT

SOUTH BASS ISLAND AND ISLANDERS. *The Franz Theodore Stone Laboratory, The Ohio State University, Contribution Number 10.*

By Thomas Huxley Langlois and Marina Holmes Langlois. Ohio State University, Columbus. Paper. x + 139 pp.; ill. 1948.

The authors are marine ecologists at The Ohio State University's biological laboratory on small South Bass Island (located in Lake Erie some 15 miles northwest of Sandusky on the mainland). They have made an ecological study of the Islanders among whom they have lived for more than ten years, a study which, in their own words, is intended "to show the influence of this environment upon the human community which it supports, and the influence of the people upon the island environment which supports them."

This 93-year-old island community has a stabilized population of somewhat less than 400 persons. Fishing, agriculture, and wine-producing, together with their related activities, have singularly shaped and influenced the way of life of the entire community, including its extra-island relations, and continue to do so. In summer the population is doubled by the influx of vacationists that creates the ebb and flow of the community's activities, a condition so frequently found in resort areas. In general, the authors identify the patterns of social change and the forces bringing them about with those operating in American culture at large, relating them especially to those common to rural communities.

The authors have approached their subject historically and topically, e.g., Schools and Education; Wars and Military Organizations; The Wine Industry; Power and Communications. The wealth of detail—names, dates, events—represents a careful and exhaus-

tive search of source materials and while providing "human interest" appears at times irrelevant to the authors' purposes. Too frequently the reader feels that the simple addition of detail, rather than appropriate accumulation, is at least in part the result of the authors' attempt to compensate for their lack of focus and weak synthesis in handling the material. The reader with even a slight acquaintance with sociology and psychology will be quick to discern the greatest weakness of this monograph—that of its static and arbitrarily topical approach, in which the parts are not interrelated to produce a meaningful and dynamic analysis of the life of the community as a whole. The pervasive effects of drastic seasonal alteration in the population of the Island, for example, have not been taken into account. Almost no recognition has been given to the disruptive consequences of this in the development and maintenance of balanced social and economic processes.

Except in the final chapter, Resumé and some Generalizations, the reader is left almost solely to his own resources to synthesize the segments of Island life and history which have gone before. He may, therefore, be unprepared for the conclusions and interpretations presented by the authors. The authors' anecdotal, unstructured, and descriptive style leaves their conclusions more open to question than would otherwise be the case. However, the generalizations and interpretations seem much better than the facts and data they are based on, at least those made available to the reader. Though leaning heavily upon moral and ethical explanations, they are none the less arresting and provocative.

The findings of this study fundamentally question "the tenability of the theory that every individual has the right to pursue his economic self-interest as a priority to and independent of his obligation to perform functions which will be of benefit to his fellow men." The burden of the evidence is construed as supporting Tawney's view that "if a society is to be healthy, men must regard themselves, not as owners of rights, but as trustees for the discharge of functions." The evidence is that on South Bass Island the inhabitants, in relation to the resources of their limited land mass, have been maladaptive and destructive to a point where "future use of the island will be limited to transient occupation, with the importation of essential supplies, or to continuous support of a very small number of people on a self-sustaining basis."

Although the authors have fallen short of fulfilling their ambitious purpose, they have made an unusual and intrinsically interesting contribution to the scant but growing literature on human ecology in times when we are with overwhelming reason properly concerned with problems of conservation, population, and human survival.

JOSEPH C. FRANKLIN

THE SEXUAL SIDE OF MARRIAGE.

By M. J. Exner. Pocket Books, Rockefeller Center, New York. 25 cents (paper). xii + 170 pp.; ill. 1948.

This is a pocket-sized reprint of one of the best books of its kind, first published in 1932. No critical comment could surpass that of Havelock Ellis, quoted on the cover: "An admirably sound and temperate presentation of the sexual problems of marriage, plain-spoken but always in the right tone, and in my opinion suitable for the widest use." Its contents include the following chapters: Sex in Life; The Sex Mechanism; Sex Differences; Sex Factors in Maladjustments; Other Factors in Maladjustments; Factors in Ideal Marriage; and The Family. The book does not consider sex from a fundamental genetic and evolutionary point of view; and of course it is pre-Kinsey.

SEX LIFE IN MARRIAGE.

By Oliver M. Butterfield, with Foreword by Sophia J. Kleegman and Illustrations by Robert L. Dickinson. Emerson Books, New York. $2.00. 192 pp.; ill. 1947.

Like the book just reviewed, this is a reprint of a guide to well-adjusted sex life. It was first published in 1937 (see QRB 13: 116). It considers Marriage Patterns, Sexual Attitudes and Emotions, The Organs of Sex, Planning the Honeymoon, The Technique of Sexual Intercourse, The Frequency of Sex Intercourse, Children, and Overcoming Sexual Maladjustment. It too fails to consider the fundamental biological functions of sex and is pre-Kinsey.

BIOMETRY

THE KELLEY STATISTICAL TABLES. *Second Edition Revised.*

By Truman Lee Kelley. Harvard University Press, Cambridge; Geoffrey Cumberlege, Oxford University Press, London. $5.00. x + 223 pp. 1948.

These tables are a revision and extension of the author's 1938 tables. The contents are as follows: Table I, eight-place normal distribution, simple correlation, and probability functions; Table II, five-place three-point interpolation coefficients; Table III, ten-place four-point interpolation coefficients; Table IV, ten-place six-point interpolation coefficients; Table V, eleven-place eight-point interpolation coefficients; Table VI, four-place χ^2 functions; Table VII, eight-place square roots, cube roots, and natural logarithms; Table VIII, eight-place θ functions for normalizing F for the variance ratio; and Table IX, constants frequently needed. A 34-page introduction describes the use of these tables.

Table VIII should be especially useful to the research scientist.

These tables will be indispensable to any statistical laboratory, and professional statisticians will almost certainly want to own a copy of them. They are probably far too detailed and complicated, however, for ordinary students of statistics or research scientists.

A. CHAPANIS

DE OMNIBUS REBUS ET QUIBUSDAM ALIIS

ENGLISH-SPANISH CHEMICAL AND MEDICAL DICTIONARY *Comprising Terms Employed in Medicine, Surgery, Dentistry, Veterinary, Biochemistry, Biology, Pharmacy, Allied Sciences, and Related Scientific Equipment.*

By Morris Goldberg. McGraw-Hill Book Company, New York and London. $10.00. x + 692 pp. 1947.

This excellent dictionary gives the Spanish equivalents and definitions of more than 40,000 of the most important English words used in medicine, surgery, dentistry, and allied biological sciences. It has been prepared to meet the needs of translators, export managers, chemists, physicians, nurses, and others who need a knowledge of biological terms in Spanish. Not only is it comprehensive, but the Spanish equivalents of English terms have been selected with precision, and the Spanish definitions are clear and succinct.

J. BARBA

WRITING THE TECHNICAL REPORT. *Second Edition. By J. Raleigh Nelson. McGraw-Hill Book Company, New York and London.* $3.50. xiv + 388 pp.; ill. 1947.

This book reviews the considerations which bear on the design and composition of the engineering report. Parts are devoted to specific directions for the setup of the report and a systematic procedure for critically examining it. It is especially designed for the engineering student.

DAVID B. TYLER

SCIENCE IN PROGRESS. *Fifth Series.*

Edited by George A. Baitsell. Yale University Press, New Haven; Geoffrey Cumberlege, Oxford University Press, London. $5.00. xvi + 353 pp.; ill. 1947.

This is the fifth series of public Sigma Xi lectures. The format of the book is excellent in all respects; and the ten lectures, with an introduction, The Future of Scientific Research in the Postwar World, by Frank B. Jewett, offer an authoritative and diversified picture of science in America at its best. The contents include: The Interior of the Earth, by James B. Macelwane; Development of Betatron and Applications of High-Energy Radiations, by Donald W. Kerst; Contact Catalysis between Two World Wars, by Hugh S. Taylor; Fundamentals of Oxidation and Respiration, by L. Michaelis; Complement: Immunity Intensifier, Diagnostic Drudge, Chemical Curiosity, by Michael Heidelberger; Genes and the Chemistry of the Organism, by G. W. Beadle; Concerning the Cancer Problem, by Peyton Rous; Plant Diseases Are Shifty Enemies, by E. C. Stakman; Living Cells in Action, by Carl Caskey Speidel; and Recent Advances in Our Knowledge of the Anterior Pituitary Hormones, by Herbert M. Evans.

BENTLEY GLASS

THE ELECTRON MICROSCOPE. *Its Development, Present Performance and Future Possibilities.*

By D. Gabor. Chemical Publishing Company, Brooklyn. $4.75. viii + 164 pp.; ill. 1948.

The biologist may well be discouraged by the formidable mathematical derivations presented in this volume. However, the accompanying text is written with unusual clarity and permits the reasoning to be followed with the aid of the excellent diagrammatic presentations. An exact understanding of the mathematics is not essential to general comprehension of the principles involved. And some chapters are entirely non-mathematical.

The close analogy between the effect of axially symmetric electric and magnetic fields on electron beams and the effect of suitably refractive media such as glass on beams of light is clearly explained. The "lens properties" of the former so closely resemble those of glass that the classic defects of optical lenses are all present, spherical aberration, chromatic aberration, and coma being important. In optical lenses the spherical aberration and coma have been successfully corrected in aplanats, and all three errors in apochromats. Spherical and chromatic aberration cannot be corrected in electron lenses, but the intensity of the beam can be increased by a factor of millions, which is impossible with visible light. Hence extremely small apertures that use only the axial area (which approaches perfection even in poor lenses) are used to achieve the very high resolution now possible. Elimination of the lens astigmatism has brought this value to 8–10 Å.

The phase contrast principle of Zernicke, recently applied successfully in optical microscopes, has also been detected in the electron microscope. It appears that very thin objects are able to refract and retard electron waves in the same manner. For the electron microscope the principle is as yet undeveloped but is regarded as promising. There is now being developed in the College de France in Paris an even more powerful

instrument, the proton microscope. Using atomic hydrogen ions, instead of electrons, it is expected by its theorists to achieve a limit of resolution of about 1 Å. Since no detail in nature is finer than 0.5 Å, it appears that the problem of resolution is close to the absolute limit.

Although formidably technical in appearance, this fine volume can be recommended to the biologist for clarification of the subject. Little is said in it, however, about the vexing problems incidental to the nature of the instrument itself (examination in vacuo, fixing, sectioning, and staining of suitable preparations, penetrability, etc.) which have thus far limited its application to biology. Bibliography and index are adequate.

F. N. Low

Carnegie Institution of Washington Year Book Number 46, *July 1, 1946–June 30, 1947, With Administrative Reports Through December 12, 1947.*

Carnegie Institution of Washington, Washington, D. C. $1.00 (paper); $1.50 (cloth). xxxvi + 211 pp. + 6 plates; text ill. 1947.

In addition to the regular reports, the *Carnegie Yearbook* always contains summaries and advance reports of the scientific research being conducted by the investigators in its several departments. Biologists will turn with interest to the reports of the Division of Plant Biology, the Department of Embryology, the Department of Genetics, and the Special Project of Ross G. Harrison.

In the first of these, one finds reports of work on chlorophyll and photosynthesis, using the alga *Chlorella;* of the successful breeding and selection of hybrids of *Poa* adapted for growth in various Western climates; of the studies in experimental taxonomy by Clausen, Keck, and Hiesey, which form a highly important chapter in modern research upon evolutionary problems; and of the work of Chaney on the Tertiary forests of the John Day Basin in Oregon. At the Department of Embryology a revised program of investigation is gaining impetus in studies of the experimental embryology of the sex organs, physiological studies of the placenta, the uterus, and the fetus, and the histology and physiology of the reproductive cycle. The collection and study of very early human embryos is being continued. At the Department of Genetics McClintock has continued her studies of mutable loci in maize, Kaufmann has accumulated further information regarding the interactions of mutagenic agents, crystalline and purified ribonuclease for cytochemical studies has been prepared, MacDowell has confirmed the existence of a maternal age factor in mouse leukemia, and the work with chemical mutagens acting on *Drosophila* and bacteria has been pressed by Demerec and his coworkers. Visitors to the Cold Spring Harbor laboratory have added to the productive program of research with studies of the mutation rate in dividing bacteria (Beale) and of the chromosome differences between germ line and soma in cecidomyids (White). Dobshansky's work on wild populations of *Drosophila* continues to throw light on the high selection differentials between inversion strains. Ross Harrison, working upon a special grant, has made studies of wound healing and reconstitution of the central nervous system after removal of parts of the neural plate.

The *Yearbook*, as a whole, is a most inspiring evidence of the possibilities of wisely directed and organized scientific research that yet leaves as much freedom as possible to the individual investigator.

Bentley Glass

After-Dinner Science.

By Kenneth M. Swezey. Whittlesey House, McGraw-Hill Book Company, New York and London. $3.00. x + 182 pp.; ill. 1948.

This is a book of popular science which, as its name implies, will hold considerable interest for amateur scientists. Its novelty and usefulness will be appreciated most by experienced scientists and teachers, however. It contains descriptions and illustrations of 111 experiments or demonstrations which can be carried out with household articles which are available in most homes, or which in any case are easily obtainable. The most interesting feature of this book is the choice of illustrations, but enough descriptive information has been given to indicate the nature of the phenomena which are demonstrated in each experiment.

S. R. M. Reynolds

The Origin of Granite. *Conference at Meeting of The Geological Society of America Held in Ottawa, Canada, December 30, 1947. The Geological Society of America Memoir 28.*

James Gilluly, Chairman; containing papers by H. H. Read, A. F. Buddington, F. F. Grout, G. E. Goodspeed, and N. L. Bowen; discussion by 26 authors. The Geological Society of America, New York. $1.80. viii + 139 pp. + 9 plates + 3 maps; text ill. 1948.

Batholith and Associated Rocks of Corona, Elsinore, and San Luis Rey Quadrangles Southern California. *The Geological Society of America Memoir 29.*

By Esper S. Larsen. The Geological Society of America, New York. $4.50. x + 182 pp. + 7 plates + 1 map; text ill. 1948.

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